THURSDAY, APRIL 15, 1915.

COLOUR VISION.

An Introduction to the Study of Colour Vision. By Dr. J. H. Parsons. Pp. viii + 308. (Cambridge: At the University Press, 1915.) Price 12*s.* 6*d.* net.

THE whole subject of colour vision is admittedly very difficult, as the knowledge of it involves familiarity with the experimental results of a physical as well as of a physiological laboratory, with the minute anatomy of the retina, and with the latest results of psychological research. Hitherto, all that is known, and the various suppositions that have been made about the subject, could only be learnt by a prolonged search through innumerable scattered papers on physics, physiology, medicine, and psychology in various languages, chiefly English and German; so that it is with most cordial thanks to the author that this *résumé* of the subject in its present state is welcomed.

The book is divided into three parts: part i. (pp. 1–157) devoted to "The Chief Facts of Normal Colour Vision"; part ii. (pp. 158–192), "The Chief Facts of Colour Blindness"; and part iii. "The Chief Theories of Colour Vision." The arrangement is admirable, the facts are well described with very few omissions, and no one after reading the first 191 pages will be surprised that so far no theory has been suggested that will account for all the facts. Perhaps a few of the difficulties of the subject may be indicated.

A given colour may be determined as is well known by its hue, its luminosity, and by its degree of saturation. It is not always remembered that:—

"Great increase of intensity of light not only alters its hue, but also alters its saturation, so that eventually it produces only the sensation of white light. It would seem, therefore, that luminosity is in some recondite sense an inherent 'whiteness' in the colour itself, differing in degrees in different spectral colours and varying with the intensity of these colours. Clearly we are here at the outset face to face with a *physiological* fact of immense importance, and much of the difficulty of colour vision is connected with this fact" (p. 29).

There is the obvious difficulty in comparing the luminosity of two different coloured lights, arising from the fact that they give rise to two different impressions, and we are surprised to find that, according to the note in the preface, there is no discrepancy when the luminosity is measured by the equality of brightness method or by the flicker photometer. The curious coloured phenomena of rapid, intermittent stimulation of the retina (*e.g.* Benham's top) lead us to expect that there would be a marked discrepancy. However, the author's statements are fully borne out by Ives's results with the flicker photometer.

On p. 3 a sentence that refers to the diffraction spectrum has missed correction when the proofs were read:—

"It suffers, however, from the disadvantage that the spectrum is less bright and less extended than the prismatic spectrum, and from the still greater objection that the interference spectrum is never free from scattered light."

Surely the extent of the spectrum depends entirely upon the fineness of the grating, and its brightness may be increased by increasing the size of the grating; and if by the term "interference spectrum" is meant a diffraction spectrum, any impurity in it is due to the faultiness of the grating.

We are glad to notice Mr. Parsons's criticism of v. Helmholtz's spectro-photometer and similar instruments in which the intensity of light is reduced by means of Nicol prisms; much of the German work on the subject is inaccurate owing to the polarising methods used.

With regard to Weber's law, the important point mentioned on p. 20 that "it does not hold good for very low or very high intensities of stimuli" is to be borne in mind. Fechner's law is true within the limits that Weber's law holds. Schirmer found that it was true between 1 and 1000 candle-power illuminations (*i.e.* the function is continuous between these limits), but that at first his minimum difference was $\frac{1}{128}$, while after eight days' practice he could recognise a change of $\frac{1}{217}$ or even less (see *Ophth. Rev.*, vol. x., p. 179). Possibly the failure of the law at the lower limit might be explained by Fechner's later addition of a term s_0 to represent the "intrinsic light of the retina." If E denote the sensation, and S the stimulus, Fechner's law then takes the form

$$E = C \log(S + s_0) + C'$$

where C and C′ are constants. Mr. Parsons makes no reference to this suggested emendation. The failure of the law at the upper limit may be due to changes in the mechanism verging on the pathological. The variation of the minimum distinguishable difference not only in each individual, but also according to his practice (as in the case of Schirmer), necessitates great precautions being used in the application of Fechner's law.

When the eye has been kept in the dark for

twenty minutes or so, the condition of scotopia or twilight vision is developed, in which the retinal sensibility is enormously increased; it will now be found that if the illumination be very low the eye is absolutely colour blind. The curve of luminosity in such an achromatic scotopic eye is practically identical with the luminosity curve of the spectrum in any colour-blind person (p. 53), the brightest part of the spectrum being near the E line (530 $\mu\mu$) instead of near the D line (580 $\mu\mu$) as in the normal eye.

The phenomena of simultaneous and successive contrast and fatigue are dealt with in pp. 100–129, and then there follows an interesting account of the researches on the discrimination of colour by various animals and by primitive races. Conclusions about both of these must necessarily be indefinite. With regard to the latter, the mural decorations of ancient Egypt show that the sense of colour for red, yellow, green, and blue was well developed five or six thousand years ago.

Limits of space forbid a review of Part iii. on the various theories of colour vision: the duplicity theory—that the cones are the seat of impulses that lead to colour perception, while the rods are only influenced by light stimuli; the three components theory (Young, Helmholtz); the three opponents theory (Hering); and seven other theories are described and criticised with justice and judgment. The author is to be congratulated on producing a work that contains an immense amount of information with a good bibliography on the subject. He has given us an excellent general and unbiassed view of the facts and theories of colour vision.

THE EXPERIMENTAL METHOD IN MEDICINE AND SURGERY.

Animal Experimentation and Medical Progress. By Prof. W. W. Keen. With an introduction by Dr. Charles W. Eliot. Pp. xxvi+312. (Boston and New York: Houghton Mifflin Company, 1914.) Price 7*s.* 6*d.* net.

IN America there are very few surgeons more eminent, more beneficent, or more widely beloved than Prof. Keen. He fulfils and represents the very highest traditions of American surgery. He has done great things in practice, and in teaching, and in writing; and his name is held in reverence by doctors and surgeons over here. So, when he writes a book for general reading on a medical subject, the general reader had better read it: especially as it has an introduction from Dr. Charles W. Eliot, sometime president of Harvard University. Besides, the book is admirably written, full of learning, full of sympathy, full of a thousand facts touching man's daily welfare.

It is a justification, and more than justification, of experiments on animals for the advancement of the science and art of medicine and surgery. Prof. Keen is one of those leaders of his profession who are very sensitive to the brutal abuse and false witness of the "anti-vivisectionists." Whether it is wise to care so much what they say, each man must settle for himself. Anyhow, Prof. Keen does care very much indeed. He takes it to heart that these wild people are set to insult the medical profession, to give the lie to plain facts, and to attack with virulent language the very methods which they themselves take advantage of when they are ill. These people seem to be just as unkind and untruthful in America as they are here. Indeed, we are having a rest from them here, since the war began; except that some of them are trying to stop our soldiers from being protected against typhoid fever. It will be a grand thing, after the war, if we can keep anti-vivisection down, and give ourselves to worthier pursuits.

The book is a collection of essays, from 1885 to 1913, on the debt which mankind and the animal world owe to experiments on animals; and on the character and the attitude of anti-vivisection. The essays are complete, final, authoritative; they are the work of a master of surgery, a leader among surgeons. Where all are good it is hard to prefer one before another. Among those essays which review the benefits gained from experiments on animals, nothing could be better than "Recent Progress in Surgery," "Vivisection and Brain-Surgery," and "What Vivisection has done for Humanity." Among those essays which review the moral obliquity of anti-vivisection, nothing could be better than "The Influence of Anti-vivisection on Character," and "The Anti-vivisection Exhibition in Philadelphia in 1914." These two essays are masterpieces; they are gentle, quiet, courteous; but they expose a state of mind, in some American women, which is not pleasant to contemplate. Things were bad enough here, up to last August; but they seem even worse in New York.

Indeed, that is one of the strongest arguments against anti-vivisection—that it tends, unless it be held under self-control, to such amazing dishonesty, such greedy willingness to believe evil of other men, such loss of the sense of responsibility and of restraint.

But these faults, after all, are not the main theme of the book: and the work of nailing lies to counters is less important to us than the work of setting forth the great discoveries of medical and

surgical science and art, especially those discoveries which have been made within the last half-century. These chapters of history are as good as good can be, and here is a book full of good reading, written by one of the chief of living surgeons. STEPHEN PAGET.

PURE MATHEMATICS.

(1) *A Treatise on the Analytic Geometry of Three Dimensions*. Fifth Edition. Vol. xi. By Dr. G. Salmon. Pp. xvi+334. (London: Longmans, Green and Co., 1915.) Price 7*s*. 6*d*. net.

(2) *A Course of Pure Mathematics*. By G. H. Hardy. Second Edition. Pp. xii+442. (Cambridge: At the University Press, 1914.) Price 12*s*. net.

(3) *Proceedings of the London Mathematical Society*. Second Series. Volume xiii. Pp. liii+500. (London: Francis Hodgson, 1914.) Price 25*s*.

(1) IT cannot have been an easy task to prepare the new edition of Salmon's classical treatise; the result may be considered quite satisfactory, although, no doubt, different readers will form different opinions about the choice of additions that has been made. In this volume, the principal ones are as follows:—First of all, a considerable addition has been made to the section on line-geometry. So far as we can judge, this has been very well done; it includes Ribaucour's theory of isotropic congruences, a good deal about normal congruences, and other interesting matter. Next, and partly connected with the foregoing, we have an account of curvilinear co-ordinates, triply orthogonal systems, and cyclides; also other theorems due to Ribaucour.

In the part dealing with cubic and quartic surfaces, there is a sketch of Segre's analysis of the singularities of cubics; Geiser's correspondence of lines on a cubic with bitangents of a plane quartic; and some very good articles on cyclides, and the special quartics of Steiner and Kummer. Towards the end of the book, we have eight pages or so on birational transformations, with some useful references, and a revised table of singularities, mainly based on Zeuthen's memoir of 1876 (*Math. Ann.*, x.). This last does not seem to be quite up to date; for instance, no reference has been made to the work of Enriques and Castelnuovo, and their discussion of the deficiency of a surface, which has yielded a new fundamental characteristic, besides that called the deficiency in this book.

Reference is made (Art. 527*a*) to some recent work on the reduction of a cubic to the canonical form $\sum_1^5 x_i^3 = 0$, and the proof that this is unique. One way of doing this is to obtain the equation $\Pi x_i = 0$, by a combination of invariants and covariants; this the present writer succeeded in doing a good while ago, with the help of Salmon's list of invariants, but the result was unpleasantly long.

Perhaps the most striking omission in the revised work is that of the theory of minimal surfaces. It would not have taken very many pages to give a fair account of this elegant theory, now that Lie and Weierstrass have reduced it to its simplest form. However, it may fairly be said that a student who has this work, and Prof. Forsyth's "Differential Geometry," will be able to make acquaintance with all the most important divisions of the subject, and be able to follow up any one in which he is specially interested.

(2) It is gratifying to see that Mr. Hardy's excellent treatise has so soon reached a second edition; and it helps to justify the statement in the preface that "it is no longer necessary to apologise for treating mathematical analysis as a serious subject worthy of study for its own sake." The author combines, in a remarkable way, strictness of method with an agreeable style; and his choice of topics seem to us to be eminently judicious. The principal additions in this re-issue are an account of Dedekind's theory of irrational numbers; a proof of Weierstrass's theorem about points of condensation, of the Heine-Borel theorem, and of Heine's theorem about uniform convergence; the notions of "limits of indetermination" and "implicit function" are also discussed. To save space, some analytical geometry and trigonometry has been deleted. The examples are well chosen, and hints towards solution are frequently given. This book, and Mr. Bromwich's "Infinite Series," to which Mr. Hardy refers in his preface, ought to do a great deal towards making school and college mathematics more rigorous, without making it repulsive; on the contrary, the apparent paradoxes explained, and the latent fallacies exposed, ought to provide a certain amount of fun, even for an undergraduate.

There are one or two very trifling points that may be noticed. On page 231, $D^{-1}(x^{-1})$, when x is negative, is defined as $\log(-x)$. This is very artificial, especially as the figure, page 359, implies that $\log x$ is undefined when x is negative. The same complaint of artificiality applies to the treatment of differentials (page 280). A rather more important point is on the proof (page 313) that the sum of a series of positive terms is the same "in whatever order the terms are taken."

This certainly requires more explanation than is given. The words "of course no terms must be omitted" begs the whole question; the sum is a *limit*, and we cannot take all the terms. Perhaps the following might be suggested. Let $\sum_1^\infty u_m$ be convergent as it stands, so that $\mathrm{Lt}(m\to\infty)u_m=0$. Let $\sum_1^\infty v_n$ be so related to Σu_m that there is a one-one correspondence of terms, so that we can write

$$u_m = v_{m'}, \quad v_n = u_{n'},$$

where m', n' are determined by m, n respectively. Suppose *further* that when $m\to\infty$, then $m'\to\infty$, and that when $n\to\infty$, then $n'\to\infty$; in these circumstances we can infer that $\Sigma u_m = \Sigma v_n$. So far as Mr. Hardy's proof goes, we might infer that—

$$u_1+u_2+u_3+\ldots = u_2+u_3+u_4+\ldots$$

but this is not true, unless u_1 occurs at a finite place on the right.

(3) The contents of the last volume of the London Mathematical Society's proceedings are, as usual, very varied, and only a very gifted or very conceited reviewer would venture to express an opinion on the absolute or relative value of the different papers. As specimens, we note Mr. Bromwich's on Foucault's pendulum, Mr. Burnside's on prime-power groups, Mr. Carslaw's on Green's function for $\Delta^2u+k^2u=0$, Mr. Hobson's on the linear integral equation, and Sir J. Larmor's on the electromagnetic force on a moving charge. There is also an interesting paper by Mr. Mordell on the diophantine equation $y^2-k=x^3$. Altogether, the volume gives an encouraging view of the state of English mathematics, except for the lack of geometry, especially pure geometry. This is becoming really a serious symptom; not only is there an element of culture in geometry which analysis does not possess, but there is a risk of our studying the whole science from a one-sided point of view, even if (as is probable) strict mathematical geometry is reduced to formal logic applied to a few indefinable axioms. G. B. M.

PSYCHOLOGY AND PHILOSOPHY.

(1) *The Foundations of Character, Being a Study of the Tendencies of the Emotions and Sentiments.* By A. F. Shand. Pp. xxxi+532. (London: Macmillan and Co., Ltd., 1914) Price 12*s.* net.

(2) *Perception, Physics, and Reality: An Enquiry into the Information that Physical Science can Supply about the Real.* By C. D. Broad. Pp. xii+388. (Cambridge: At the University Press, 1914.) Price 10*s.* net.

(3) *Philosophy: What is it?* By Prof. F. B. Jevons. Pp. vii+135. (Cambridge: At the University Press, 1914.) Price 1*s.* 6*d.* net.

(4) *Know Your Own Mind. A Little Book of Practical Psychology.* By W. Glover. Pp. ix+204. (Cambridge: At the University Press, 1914.) Price 2*s.* net.

(1) PSYCHOLOGISTS have been slow to meet the popular demand for a science of character. Under the name ethology, it was planned by John Stuart Mill. But Mill failed to accomplish his plan. The 'laws of psychology,' upon which he proposed to base his new science, were, in his day, inadequate and unsuitable for the task. In Mr. Shand's eagerly awaited book the attempt has been renewed. Will the new attempt meet with a greater success?

Judged by Mr. Shand's criterion, it undoubtedly will. Mr. Shand no longer claims to deduce the laws of character from certain fundamental conceptions, initially established as true. He seeks rather to formulate provisional hypotheses, and to test them by their fruitfulness. His method is thus concrete and synthetic. It gives him the viewpoint of the novelist and dramatist, of the biographer and historian; and enables him to utilise their material. In place of Mill's 'laws of association' he propounds the 'principle of organisation': all mental activity tends to produce and sustain system; and, in sharp distinction from the school of Mill, and in common with others who have more recently approached his field, he seeks the springs of conduct on the instinctive and emotional side of man's original nature, rather than on its intellectual side.

In his conception of character the chief place is given to those lower systems called emotions, and those higher systems, which he has already taught us to call 'sentiments.' The influence of intelligence and will is somewhat briefly dismissed. He treats more fully the influence of temperament; and, most suggestively, that of temper.

The present volume deals in detail with each of the primary emotions. Together with fear, anger, wonder, and disgust, he includes repugnance, surprise, sorrow, and joy. Tenderness, self-assertion, and self-submission are omitted. His list thus differs a little from that suggested by Mr. McDougall. A yet deeper difference is revealed in his treatment of instinct. In Mr. McDougall's view, to each principal instinct there corresponds innately some one specific emotion. According to Mr. Shand, an emotion may include within its system several instincts, and the same instinct may be found organised in several different emotions. The difference is partly a question of fact, which future

investigation may well set itself to solve; but it is partly a question of what we are to term instincts. Emotion itself is defined so as to include a cognitive and a conative attitude, as well as one of feeling. But the part played by the former aspects is not quite as clear in the book as it obviously is in Mr. Shand's own mind; this perhaps is due to a postponement of a full treatment of knowledge, intelligence, and will to the later volume dealing with the sentiments.

Perhaps the least convincing feature of the book is the source from which Mr. Shand has collected his facts. To observational and experimental data he makes scarcely any appeal. In support of his one hundred and forty-four provisional laws he goes almost entirely to literature. To illustrate the association of qualities in various character-types he turns to Balzac and La Bruyère rather than to the correlations of Heymans and Wiersma, or the records of the followers of Binet, Stern, and Freud. In the present stage of knowledge he is perhaps justified. Doubtless, field-workers will soon come forward to collect observations, make experiments, and apply statistics. And for preliminary conceptions, problems, and hypotheses they can go to no more inspiring source than Mr. Shand.

(2) Mr. Broad's book attempts to discover how much natural science can actually tell us about the nature of the real. But, unlike recent authors who have approached this question, he deals with physical science rather than with biological. His chief philosophical concerns are perception and causation. His problems are thus those of Mach or Lotze rather than those of Bergson or Driesch. And his point of view owes much to Mr. G. E. Moore and Mr. Bertrand Russell. His treatment, however, is none the less suggestive. And his book provides an excellent refutation of Kant's dictum that, in dealing with the traditional problems, philosophy is concerned only with certainty and not with probability.

(3) The minds of most English people (so Mr. H. G. Wells has declared) will only be reached, under present conditions, by thoughts that can be expressed in the meanest commonplace. In "Know Your Own Mind" and "Philosophy: What is it?" we have two deliberate endeavours to falsify this pessimistic prophecy. Mr. Glover and Prof. Jevons have set themselves to interest the average man in two of the most abstruse and technical branches of human knowledge—philosophy and psychology. Unfortunately, philosophers and psychologists themselves may be inclined to think that the point of view represented in both is not indeed commonplace, but perhaps a trifle old-fashioned.

Philosophy and science, materialism and idealism, scepticism and philosophy, personality and the whole—these are the time-honoured themes that Prof. Jevons discusses in a masterly but time-honoured manner. They were chosen for lectures delivered at the request of a branch of the Workers' Educational Association. In the debates that followed, the burning controversies of the day, and the actual contributions of contemporary philosophers, were doubtless freely discussed; and so, perhaps, it was best that the main impression left was the enduring character of the old enduring questions. Often and ably as these have already been treated in brief, cheap, popular manuals, Prof. Jevons's little book will rank among the best.

(4) Mr. Glover's volume belongs to the same pleasantly printed and pleasantly bound series. In his endeavour to be up-to-date, he tells us, he has tried to catch something of the 'cinema spirit.' His metaphors, his similes, and his allegories are both vivid and picturesque. But his matter is not quite as up-to-date as his style. He gives us a revised and racy epitome of the traditional Herbartian psychology. But the methods and marvels of the psychological laboratory he dismisses as of little practical utility and no popular interest. Nor does he give any reference which would help his reader to realise that the knowledge of our own minds, like most other knowledge, has been largely extended by careful observation and experiment. His main purpose, however—to present the subject-matter of psychology in a light which will be intelligible and interesting to the man in the street—this he has brilliantly fulfilled.

OUR BOOKSHELF.

The Next Generation: a Study in the Physiology of Inheritance. By F. G. Jewett. Pp. xi+235. (Boston and London: Ginn and Co., 1914.) Price 3*s.* 6*d.*

THE author of this skilful little book is persuaded that the improvement of the human breed would be accelerated if people knew more biology. They perish for lack of knowledge. "Science says human beings will be safer when people know the facts, and are influenced by them. Teachers say 'Give us the facts, and we will pass them on to the boys and girls whom we teach.' Both man of science and teacher agree that the human race will be better able to escape certain kinds of peril if we let young people know what the perils are, and how to avoid them. Such is the purpose of this book."

The general facts of evolution, heredity, and development are stated with simplicity and vividness, and on this foundation the author bases her instruction in regard to the culture of adolescence,

the use of alcohol, the raising of the standard of parental fitness, and similar problems. In a detached appendix the dangers of venereal diseases are frankly pointed out. The author's general position is that much is to be attained by greater cleanliness, increased control of the hours and conditions of labour, and improved environment for children, but that there must also be some way of preventing the decisively unfit from becoming parents. The book is competent and wise, but some of the statements seem to us to require safeguarding. The citations as to child labour "in the greatest canning factory" in America are so terrible that we hope there is some mistake. The date should have been given. The book is dedicated to "Boys and Girls, the Guardians of the Next Generation," but we hope we are right in understanding that it is meant only for the teacher's use.

Principles of Physical Geography. By G. C. Fry. Pp. x+151. (London: W. B. Clive, 1915.) Price 1*s.* 6*d.*

THIS little book contains that part of the author's text-book of geography which deals with physical geography, with some additions on such subjects as map drawing, climate, and the crust of the earth, as well as a new chapter on man and his work. It contains no definite instructions for practical exercises to be worked by the pupil, but the descriptive treatment will prove suitable for students preparing for the examinations mentioned in the author's preface.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

The Thermionic Current.

IF a carbon filament lamp is silvered inside, and a platinum wire through the side of the glass makes electric connection with the belt of silver, it is easy to experiment with the thermionic current, using a telephone receiver with one terminal to the platinum wire and the other to the water mains.

With an alternating current at 110 volts, a loud note is heard, depending on the frequency of alternation. With a direct current from a dynamo there is sufficient variation in the voltage to obtain a sound just audible at 100, loud at 110, very loud at 130, and it might be described as an uproar at 140 volts. It might be expected that the intensity would increase until the lamp burnt out. Nothing of the sort. At 142 volts the uproar is replaced by dead silence, which continues up to 165 volts, as high as the lamp would stand.

The explanation may be gathered from Langmuir's paper (*Physical Review*, December, 1913). The thermionic current does not increase with the temperature, according to Richardson's law, unless the vacuum is of a high order. With a moderate vacuum the volume charge between the filament and silver causes the thermionic current to remain at a value nearly constant, as the temperature is raised above a certain value. The thermionic current begins by obeying Richardson's law ($i = a\sqrt{T}e^{-\frac{b}{T}}$), and then later approximates to a steady value.

Thus at low voltages variations of voltage cause variations of temperature and consequent fluctuations of thermionic current, heard through the telephone.

Above 140 volts, however, for the particular lamp in question, a change of voltage and of temperature produces no change of current, and hence no sound can be heard in the telephone.

It is possible that this method may prove very convenient for testing the electron emission from various substances in different gases, and it suggests a method of measuring a high vacuum. A. S. EVE.

McGill University, Montreal, March 31.

A Mistaken Butterfly.

WHILE waiting for a car at Pacific Grove, Monterey County, California, on February 12 (Lincoln's birthday) of the present year, I noticed that a man standing near me had the brightly-coloured "eye" of a peacock's feather in the band at the back of his hat. While looking at this I saw a butterfly floating above the man's head. It suddenly lighted on the "eye" and apparently began trying to extract food from it. I directed the man's attention to it; he removed his hat, and we watched the insect for several minutes as it tried to secure food from the feather. It then flew away, as if satisfied that it had made a mistake. I do not know the name of the butterfly, but it was one of many of a light brown colour that seem to be plentiful at Pacific Grove at that season. I was told that these butterflies at a certain time regularly alight in thousands upon a special pine tree (one of a great many) in the western edge of the town, and from this fact they have called it the "Butterfly Tree." I do not know whether these insects seek their food from flowers by the sense of smell or that of sight, but it was evident in the present case that this one was guided entirely by sight.

E. E. BARNARD.

Yerkes Observatory, Wisconsin, U.S.A.
March 29.

BRITISH SUPPLY OF DRUGS AND FINE CHEMICALS.

AT a British Association meeting about twenty years ago an eminent physicist received some rough handling from his chemical colleagues on account of the impurities which were manifestly present in the materials he had used in his experiments. He replied, in effect, that chemists should employ themselves in purifying chemicals for physicists to use. Nowadays chemicals such as he would have desired are made by the ton, chiefly by three firms in Germany. For ordinary chemical, and even physical, research such fine materials are turned out that it may be doubted in many cases if the work done with them is worthy of such refinement. Frequently the chemicals used are better than the chemist who works with them could have produced for himself. For work of the highest degree of refinement, such as the determination of atomic weights, the chemicals which can be purchased cannot be used with-

out much further purification, but even in these cases much time is saved by the previous elimination of the grosser forms of impurity. To those who were in their early days limited to chemicals produced in this country, the standard of purity attained by the German manufacturer came as a revelation, and the study of prices made it clear that the enormous advantage gained by the use of the German materials was obtained at no unreasonable cost. The standard set by the German makers has not even been aimed at by our own countrymen, and the words "pure," "puriss," and "absolutely pure, for examination purposes" on the labels, are ludicrously misused. Want of method, want of care, and the employment of workmen instead of chemists in the preparation are at the bottom of the failure.

With regard to drugs, it has been stated that some eight hundred different medicinal preparations have been patented within recent years by German chemists, and although this is probably an exaggeration, it is certain that a very large number of such substances have been prepared, and that many of them have been found of sufficient value from the physiological point of view to warrant their retention as commercial products.

In these days when the relationship between chemical constitution and physiological action is fairly well understood, it is clear that the discovery of an organic structure which has valuable physiological action will lead to the preparation of large numbers of others differing but slightly in composition, and that these will find their way into patent literature mainly in the hope of their being useful, and, incidentally, to retain the field for further investigation. Such was the case of salvarsan, and since the discovery of that substance by Ehrlich, the patent literature has teemed with specifications dealing with the preparation of organo-metallic derivatives of almost every conceivable description. The antipyretics, again, of which phenacetin and aspirin may be quoted as types, belong to definite groups of organic compounds, the other members of which possess more or less important properties, depending on a slight change of structure the nature of which is not definitely understood.

There is another class of drugs of which the Germans have made a special study, those which are obtained from vegetable sources. In looking through their descriptive catalogues (in English) which are largely circulated among medical men in this country, one is struck by their far-reaching enterprise in this direction. Their travellers have gone to the ends of the earth to investigate native diseases and the local remedies which are used for their treatment. So long ago as 1850, Schweinfurth, in his journeys in central Africa, compiled a list of such remedies and brought home specimens of plants from which they were made. In Germany a large trade is now done in the extracts from vegetable sources collected from the remotest corners of the globe, many of them British possessions. The medicines are sold in elegant and even attractive form, and those whose memories go back to the pre-tabloid days may well envy the younger generation. It would not be just to underestimate the work done by certain firms in this country in the same direction, but in the number of the drugs and the enterprise shown in collecting new ones, we are, without doubt, behind our enemies.

In these matters of fine chemicals and drugs, both synthetic and natural, it is an arguable question whether the trade should be left as it is. On one hand it might be said that the work is admirably done by the German manufacturers in both branches; they have large and capable staffs and works excellently fitted for the purposes for which they were built; should not these particular manufactures be left in their hands? On the other hand, we have a sense of humiliation that we should be, in any conceivable juncture, dependent on those who are at present our enemies. Certain allied manufactures, *e.g.*, heavy chemicals, are still left largely in our hands, but if we yield in the smaller trades, is it not likely that they will succeed in wresting from us the larger source of profit? There can be no convention or agreement in these matters; each country will make what profit it can in the most convenient direction. "Capturing the Enemy's Trade" makes a good newspaper heading, but it is painful to read the many impracticable suggestions which have been made on the subject since the beginning of the war. Many people seem to have the idea that all that is wanted is that a works shall be built, or even a derelict factory be adapted, and then the thing is done. No thought is given to the years of patient research, the long training of the workers, and the period which must elapse before even the raw materials could be collected.

In the particular directions with which this article is concerned there is no doubt that the thing can be accomplished in time. In one laboratory of university rank the manufacture of three synthetic drugs in large quantities has been carried on since the opening of the war, and the resulting products have been handed over to the naval hospitals which were in urgent need of them. The preliminary investigation in this piece of work occupied a staff of seven experienced workers, under the direction of the professor, two whole months before the details of the processes could be mastered. The results not only gave to the naval service what was wanted at the moment, but they enabled the details of the processes to be handed over, through a committee of the Royal Society, to three manufacturers who will produce the drugs on a large scale. In a similar way the laboratory of another institution has succeeded in working out the process of making a natural drug from its plant sources. These instances illustrate the magnitude of the task which is before us, and the amount of highly specialised labour which must be employed on the problems. It is only courting failure if the conditions necessary are not realised before a start is made.

In the matter of highly purified chemicals another point must be noticed. The reputation of the German makers is high, and deservedly so, and it follows that it will be a long time before possible rivals, even if they produced materials of an equal degree of purity, could obtain the same degree of confidence in the minds of their customers. In order to give this confidence it has been suggested that the object might be most quickly attained by the establishment of a National Chemical Laboratory analogous in constitution and management to the National Physical Laboratory, in which the products of the manufacturers could be tested and the standard of purity guaranteed. The scheme would undoubtedly serve to hasten matters. The guarantee of the National Physical Laboratory is accepted as impartial and accurate throughout the world, and there is no reason why a chemical institution of the same kind should not command equal confidence. Into the question of cost there is perhaps no need to enter, but the fact must be faced that the average man would not expect to pay a much higher price than he has paid heretofore because the substances were made in England. H. B. BAKER.

HOME FORESTRY AND THE WAR.

IN an article in NATURE of December 10, 1914, p. 393, it was shown how dependent we were upon foreign countries for our supplies of pitwood, without which coal-mining could not be carried on. About half the total amount of pitwood exported in normal times into the United Kingdom comes from Baltic ports; and as a result of the action of Germany in declaring pitwood contraband, the supplies from this source have practically ceased, what now arrives from Scandinavia being merely small cargoes from Gottenburg, Christiania, and other ports outside the Baltic. The important supply of pitwood from France, Spain, and Portugal still continues, though at enhanced prices; and in case of need, large quantities can be obtained from Nova Scotia, Newfoundland, etc. Nevertheless, it became necessary to ascertain the available amount of home-grown timber suitable for use in mining; and an inquiry into the subject was undertaken by the forestry branch of the Board of Agriculture, the report of which has been issued with great promptitude. From this it appears that the total area of woodlands in England, 1,884,000 acres, is capable of yielding 380,000 tons of pitwood annually by normal fellings; and that by anticipating the fellings of the next five years almost 3,400,000 tons of pitwood are available in England and Wales alone. Scotland by similar extraordinary fellings could supply about 2,500,000 tons; so that with the aid of a small quantity from Ireland, about 6,000,000 tons of pitwood could be felled, enough to keep the collieries going for eighteen months, as their average annual consumption of pitwood is approximately 4,500,000 tons.

In the *Quarterly Journal of Forestry*, January, 1915, pp. 1–7, Sir W. Schlich, criticising the preceding report, asks what will be the position if the war should last for more than two years; and considers that in this case our coal mines would be obliged to shut down for want of pitwood. As labour in Canada is very expensive, he believes that supplies of mining timber from Nova Scotia, etc., may prove unavailable on account of the prohibitive cost. He urges upon the Government the necessity of taking early steps to increase the area under trees in these islands, and reiterates well-known arguments that, however sound, appear to have little effect upon our rulers. He sums up as follows:—

Forest schools have been set up for instruction in forestry; a forestry branch has been established in connection with the Board of Agriculture and another in Ireland; an officer has been appointed to convert the Dean and High Meadow Woods into a demonstration area. All this is in the right direction, but *very little has as yet been done to increase the area under forest.* Too much talking and too little action—that is the long and short of it. Let us hope that the new situation will lead without further loss of time to action. Of course, I should not advocate the taking of a single acre out of cultivation, because the production of food goes before everything else; but there are large stretches of land unfit for cultivation and yet quite fit to produce forest crops. Nor should I advocate the formation of large blocks of woodland, all in a ring fence as it were. No, what I look forward to are moderate sized areas scattered over the country. As long as the area is sufficiently large to justify placing a woodman in charge and also sufficient to be placed under systematic management, say a minimum of 500 acres, we shall have all that is required. In that case agricultural labourers and tenants of small areas will in time come forward and do the bulk of the forest work during the winter months, when agricultural work is practically at a standstill, thus improving their resources. Such a scheme will not be perfection all at once, but it will come by degrees. Only let the Government, with funds allotted by the Development Commissioners, start actual work, even on a small scale; it is sure to grow.

Another article in this journal deals also with the subject of pit-timber, and reviews the result of an independent inquiry by the English Forestry Association. Further articles treat of the preparation of yield tables, which are necessary in the estimation of the financial returns that are probable, when waste lands are afforested. Mr. Hiley writes a preliminary report on an investigation at Oxford into larch canker, and advocates a means of treatment which is scarcely advisable on account of the expense, not to mention the fact that the mode of infection on which the treatment is based is not yet clearly demonstrated to be the actual one.

In the *Transactions of the Royal Scottish Arboricultural Society*, xxix., part i. (January, 1915), the production of pitwood on wooded estates in Scotland is investigated by Mr. J. H. Milne Home, both as regards the present crisis and also with a view to a permanent increase in the supplies of mining timber in the future. Mr. Home considers that one-fourth of the normal

amount required by British collieries could be readily supplied from Scotland, if railway rates of freight could be reduced by 25 per cent. An admirably illustrated paper by Mr. P. Leslie deals with the afforestation of the coastal sand dunes at Culbin, between the rivers Nairn and Findhorn. The Culbin sands have a remarkable history, as they conceal an estate of 3600 acres, which was once the richest agricultural district in Morayshire. The incursion of the sand took place suddenly in 1694, leaving a wilderness until 1865, when Major Chadwick began plantations, which have been continued by his son. The species mainly used has been been Scots pine, but Corsican pine wherever planted has given the best results, producing tall, clean poles of valuable timber. The operations, which include the prior fixing of the moving sands (Fig. 1) by maram grass, are carefully described, and are similar to those used by the French in the Landes.

Photo] [*Geological Survey.*

FIG. 1.—Culbin Sand-hills, Elginshire: near the Binsness Plantations. The background shows a travelling dune of advancing sand. The steep bank with cornice atop and slipping sand on slope, the tails of sand behind the tufts of bent, and the wind ripples in the foreground, indicate that the sand-drift is from left to right, *i.e.*, from west to east.

Wood-charcoal and its uses is the subject of an article by Mr. W. D. Ashton Bost, who states that the only firm in Britain which reduces iron-ore by charcoal is that of Messrs. Harrison Ainslie. Their charcoal furnace at Backbarrow on the river Leven in Cumberland produces annually about 2400 tons of so-called "Lorn" charcoal pig-iron, which is the dearest iron in the market, and is exported for special uses to all parts of the world.

The production of potash salts from woodlands and wastelands is the subject of a timely article by Mr. G. P. Gordon. It is probable that the material obtained by burning lop-and-top and brushwood in plantations and bracken fern on wild hill-sides, together with the ash of furnaces, using sawdust as a fuel, can compete successfully with kainit, which has been for many years the main source of the potash salts that enter into the composition of artificial manures. There is an account of a peculiar witches'-broom infesting willow trees at Hampstead and in parts of Essex near London, which appears to be hitherto undescribed. Prof. A. Henry gives an account, from Japanese sources, of the distribution of *Larix leptolepis* in its native home.

Many useful notes from continental sources are given, of which the following may be cited, taken from the Norwegian *Manual of Silviculture* by Barth:—The limit of the existence of forest trees in Norway is fixed by the mean temperature of the four months of vegetation, June to September. Birch is content with a mean summer temperature of 45° F.; aspen and grey alder with one just under 46° F.; Scots pine and spruce, 47° F.; *Alnus glutinosa*, 54° F.; oak, 55° F.; and beech, 56° F. It would be interesting to obtain similar figures regarding the limit of these species and larch in Britain.

THE CARNEGIE TRUST.[1]

THE Carnegie Trust for the Universities of Scotland has steadily pursued the policy of making quinquennial distributions of the funds at its disposal; and the present year finds the third of these schemes in operation. The total sum to be expended during the current five years was 203,250*l*. Of this, 21,250*l*. is to be applied towards providing books, etc., for the libraries of the universities; 160,750*l*. goes to supply new buildings and permanent equipment; while 21,250*l*. is to be spent on endowing lectureships and upon other general purposes.

With regard to that portion of the scheme which concerns itself with assisting students by paying their class fees, a sum of 41,789*l*. was paid on behalf of 3,900 beneficiaries in 1913–14. It is gratifying to note that in the same period 605*l*. has been repaid to the trustees by beneficiaries who had been assisted under the scheme.

The expenditure on research for the current twelve months is divided as usual under the heads of scholarships, fellowships, and grants, with the additional expenditure necessary to support the laboratory of the Royal College of Physicians in Edinburgh. 1392*l*. has been spent upon the laboratory, while the fellowships, etc., have necessitated an outlay of 7652*l*.

These sums have not been expended without good return, as the present report shows. Special mention is made of the long and conspicuously successful investigations of Dr. Margaret B. Moir on the effect of temperature upon the magnetic properties of steel; while the executive committee point to the work of Dr. Dougall on elasticity as a proof that their fellows do not relinquish research with the termination of their fellowships, but continue to bring forward investigations of first-class importance.

The scholars in the branches of chemistry and physics have published no fewer than thirteen papers during the session, and much unpublished work is still in process of completion. The research grants have aided in the production of twelve papers during the present year; and in this connection stress is laid upon the collaboration between the permanent staffs of the universities and other beneficiaries of the trust, the cases of Profs. G. G. Henderson, J. C. Irvine, and Dr. T. S. Patterson being singled out as examples of success in this respect.

In more than one direction, the war has had an effect upon the progress of the research scheme. Naturally, as far as materials go, the chemical field is the one most affected, owing to the difficulty of obtaining substances for some classes of work; but all branches have suffered owing to the enlistment of fellows and scholars in the army. No fewer than nine of the fellows and scholars have interrupted their scientific careers for this object; and it is satisfactory to learn that their positions are being kept open for them should they wish to resume research work after the war. A similar state of affairs is found in the Royal College of Physicians' laboratory, from which no fewer than nine of the workers are absent on military duty; so that this institution has been heavily handicapped during the current year.

Bearing these factors in mind, the results obtained in the operation of the trustees' scheme during the period covered by the report cannot be said to fall below the high standard attained in previous years; and it must also be recalled that many of the beneficiaries of the trust have resigned their fellowships or scholarships in order to take up permanent positions either in the universities or in other lines of professional work.

During the academic year 1914–15, twenty fellows and forty-seven scholars have been at work, while grants have been given to seventy-eight applicants. The investigations of these beneficiaries are extended over so wide a field of knowledge that it is impossible even to mention the branches of science, medicine, history, and languages in which work is being carried out; but a perusal of the report leaves the impression that the operations of the trust are steadily opening out wider and wider fields. The success of the trust's methods has never been in doubt, and the interest of observers becomes concentrated upon the developments which seem likely to flow from this vast machinery for enabling competent investigators to acquire a grasp of the methods of research, and to put the knowledge thus obtained into practice on a bigger scale than would otherwise be possible to them.

[1] Thirteenth Annual Report of the Carnegie Trust for the Universities of Scotland, 1913–14.

INEXACT ANALOGIES IN BIOLOGY.[1]

THE philosopher of the forum is notorious for the looseness of his analogical arguments from biology, and biologists themselves deserve castigation for their lax terminology. Even a Galton can write: "Parents are very indirectly and only partially related to their own children." Every word has its halo, and may be regarded according to one's point of view as either a potted poem or a tabloid theory. When the theory has been overturned, the use of the word in serious argument is dangerous. Then comes the critic to set us straight again, and so here is Dr. Johannsen putting such blessed words as "evolution," "affinity," "tradition," and "inheritance" in their proper places. So far as he condemns the use of inexact analogy, especially as a method of proof, we shall all agree with him—at least theoretically. But an analogy, strict in its application, may be falsified by its premisses. Many such are rejected by Dr. Johannsen as incorrect presentations of the facts of organic life and history. But here he often seems a little too certain that his interpretation of nature is the only right one. Belonging to the strictest sect of the Mendelians, he believes that, though the organism may respond variously to external

[1] Falske Analogier med Henblik paa Lighed, Slaegtskab, Arv, Tradition og Udvikling. By W. Johannsen. 8vo, pp. 114. (Kjøbenhavn, 1914).

conditions, the constitution of the germ is unaffected thereby, and that any change in it is necessarily discontinuous. Hence, though individual growth is inevitably continuous, organic evolution must be discontinuous; and any analogy between race-history and individual history must be false. The idea that the latter recapitulates the former "cannot be applied to concrete instances."

That likeness does not necessarily imply relationship is true enough; but there is more than "likeness" when we find the last of an ascending series of fossils repeating in its life-history the adult stages of the successive species immediately preceding it, all those stages having been linked by gentle gradations. The semblance of continuous evolution may conceivably be explained by an appeal to the mongrel (heterozygote) constitution of the germ, and by allowing wide limits of modification to the soma, in successive species. But why is the trend of germinal saltation so often the same as that of somatic modification, and why should individual growth repeat and follow this trend? These are questions not of analogy, but of fact, and are not to be dismissed with a bare denial.

Biologists may differ on these matters, but all might read with pleasure Dr. Johannsen's criticism of Prof. Bergson's "Élan vital."

F. A. BATHER.

PROF. OTTO N. WITT.

BY the sudden death, through heart-failure, on March 23, of Otto Nikolaus Witt, Geheimer Regierungsrat and professor in the Technical High School of Charlottenburg, at the comparatively early age of sixty-three, and in the full maturity of his intellectual power, Germany loses one of the most distinguished of her teachers of chemical technology, and one of the most successful of her pioneers in the application of organic chemistry to industrial pursuits. Of Russian extraction, Witt had intimate associations with all the countries now warring against Germany. Like Hofmann, Griess, Caro, Martius, and others who could be named—the founders of Germany's unrivalled supremacy in the manufacture of the so-called coal-tar dyes—upwards of thirty years ago Witt spent some time in England as a member of the now defunct firm of Williams, Thomas and Dyer, then engaged in the industrial production of this class of colouring matters. He took kindly to English life, moved freely in scientific and literary circles in London, joined the Savile Club, which had then its home in Savile Row, had his boat on the river, and enjoyed to the full the hospitality which his many social gifts, the range of his knowledge, his admirable conversational powers and charm of manner readily secured for him.

Witt spoke and wrote our language with ease and fluency. *Habitués* of the Royal Institution well remember the brilliant Friday evening discourse he gave on the development of the synthetic indigo industry, illustrated with a wealth of material and a mass of detail which his close connection with the great firms which have combined to exploit that industry had enabled him to accumulate. Among the many fruits of his scientific activity in England at that time may be mentioned his paper in collaboration with Thomas, on the induline group, published in the Transactions of the Chemical Society for 1883. At another period of his career he was associated with Nölting and Grandmougin, at Mulhouse, in developing the chemistry of the indazole derivatives, and his Alsatian connections brought him into contact with the leading manufacturers of synthetic colouring matters in France, and he learned to know Paris and to appreciate its scientific interests as fully as he knew and valued those of London.

The most fruitful period of Witt's scientific activity was comprised between the years 1876 and 1892. During the earlier years of his connection with the Charlottenburg institution, he was hampered by the want of adequate laboratory accommodation, and in spite of his acknowledged position as an authority on that particular section of applied organic chemistry with which his name and fame are indissolubly associated, and notwithstanding his generally recognised powers as a teacher, his success in creating a school fell short of his hopes, and neither the number of his students nor the character of their output, as determined by the quality and number of their communications to chemical literature, were commensurate with his aspirations.

Witt was one of the earliest to attempt to explain the properties and colour of dyes in terms of chemical constitution, and his memoir of 1876, published in the *Berichte* of the German Chemical Society, attracted considerable attention by the originality and boldness of its views, and the ingenuity with which they were supported. The terms "chromophor" and "chromogen" which he introduced in order to denote the special groups and molecules which he conceived to be concerned with the production of colour are still current in the literature. Although Witt's hypotheses have not wholly stood the test of time, the paper will always have its place in the history of the subject. It is at least noteworthy as the production of a young man of twenty-four.

Witt's name is associated with the discovery of certain typical classes of synthetic dye-stuffs. His published work includes papers on the indulines and indophenols; on the nitroso-derivatives of aromatic amines, eurhodines, eurhodols, safranines, etc., and he contributed the monographs on azines, indamines and indophenols, artificial indigo and indigoid dyestuffs, and triphenylmethane colouring matters to the "Dictionary of Applied Chemistry," published by Messrs. Longmans, Green and Co. They are amongst the most valuable articles in that work, and are characterised by Witt's excellent literary qualities, his grasp of principles, his power of co-ordination, his sense of proportion, and felicity of expression—qualities

exhibited in no less degree in his frequent contributions to *Prometheus*, with which he was associated as editor for many years, a periodical which played much the same part in Germany as NATURE does among English-speaking communities.

Witt was a singularly gifted man, of great attainments, artistic and literary, of large sympathies and wide interests, far removed indeed in mental habit and outlook from what is usually regarded as the typical German professor. He had an extensive knowledge of what is best in the literature of nearly every European nation, to which his remarkable linguistic attainments gave him ready access. In early life he was attracted to biological problems, was an excellent microscopist, and rivalled Cleve in studying and delineating the lower forms of organic life. In his later years he was devoted to the culture of orchids, and was an occasional visitor to the Temple show of our Royal Horticultural Society, and a frequent purchaser at the plant auctions in London. Of his power of initiative and capacity for organisation and direction, and of his merits as a host, those who attended the International Congress of Applied Chemistry at its meeting in Berlin, of which he was president, have a pleasurable and grateful recollection. T. E. THORPE.

NOTES.

WE regret to announce the death, on April 10, in his eightieth year, of Dr. W. Grylls Adams, F.R.S., Emeritus Professor of Natural Philosophy and Astronomy in King's College, London.

THE death is announced, at nearly sixty-two years of age, of Dr. Louis Waldstein, author of "The Subconscious Self," and of many articles on pathological subjects.

ON Monday, April 12, at a meeting of the Council of the Royal Society of Arts, the society's Albert Medal was presented to Senator Guglielmo Marconi "for his services in the development and practical application of wireless telegraphy." The medal, which was instituted in 1863 to commemorate the Prince Consort's presidency of the society, is awarded annually as a reward for "distinguished merit in promoting arts, manufactures, and commerce."

ACCORDING to a message to the *Morning Post* from its Stockholm correspondent, the projected Anglo-Swedish Antarctic Expedition, under the leadership of Prof. Otto Nordenskjöld, has been postponed until the war has been brought to a conclusion. It will be remembered that the expedition was to sail in August next.

THE death is announced of M. Edmond Rigaux, of Boulogne, in his seventy-seventh year. M. Rigaux was a well-known authority on the geology of the Boulonnais, and contributed especially to our knowledge of the Jurassic rocks and fossils of that region of France. He was a foreign correspondent of the Geological Society of London, and in 1883 received the Lyell Fund of the Society in recognition of the value of his researches.

THE Jacksonian prize of the Royal College of Surgeons for 1914 has been awarded to Mr. Jonathan Hutchinson for his essay on the pathology, diagnosis, and treatment of trigeminal neuralgia, and the John Tomes prize to Mr. J. F. Colyer for his work on comparative dental anatomy and pathology. The subject of the Jacksonian prize for 1916 will be "Methods and Results of Transplantation of Bone in the Repair of Defects caused by Injury and Disease."

PROTOZOOLOGISTS and marine biologists will be interested to learn that the whole of the collections and library of the late Fortescue W. Millett, of Marazion and Brixham, have been acquired by Mr. Heron-Allen, and will be incorporated as a special section of the Heron-Allen and Earland collection, to which the collection of the late J. D. Siddall, of Chester, was also added recently. It is hoped that this entire collection, numbering some 10,000 slides, and the library which accompanies them, will ultimately be incorporated with the Museum of Oceanography and Marine Biology, which it was the ambition of the late Sir John Murray to found. Broadly, his object was to form his collections of material and soundings into a department of the Natural History Museum in conjunction with the H. B. Brady and W. B. Carpenter collections, which are already there. The co-ordination of the Brady, Carpenter, Murray, Millett, Siddall, and Heron-Allen and Earland collections would form a reference museum of oceanic deposits and type specimens without an equal in the world.

THE death is announced at the age of sixty-three of the well-known bacteriologist, Friedrich Loeffler, director of the Institute of Infectious Diseases, Berlin, and formerly Professor of Hygiene and Director of the Hygienic Institute, University of Greifswald. Loeffler's name is best known as the co-discoverer with Klebs of the diphtheria bacillus; this was in 1884. A year or two previously the presence of peculiar bacilli in the diphtheritic membrane was noted by Klebs, but it was Loeffler who afterwards isolated and cultivated this organism. With Koch and Gaffky, Loeffler carried out investigations on disinfection with steam at the Imperial Institute of Hygiene, Berlin, and he showed the keenest interest in the comparative study of the infectious diseases of animals, such as the diphtheria of calves and of pigeons. He was with Schütz the discoverer of the nature of the causative organism of foot-and-mouth disease, which he proved to belong to the group of micro-organisms known as "filter-passers," which owing to their minuteness are invisible with the highest powers of the microscope, and are capable of passing through the pores of a porcelain filter. To Loeffler also belongs the credit of achieving some of the early work associated with the application of aniline dyes to the staining of bacteria, "Loeffler's Methylene Blue" being used to this day as a routine laboratory stain. Loeffler's name will ever rank with those of Pasteur, Koch, and Ehrlich as a pioneer in the domain of bacteriological research.

THE death of Major Samuel Flood-Page removes from the electrical world an interesting personality who played no small part in two important developments—electric lighting and wireless telegraphy. His first notable achievement after leaving the army was the organisation of the Electrical Exhibition at the Crystal Palace in 1882, when he was acting as manager of that institution. About this time the problem of the subdivision of the electric light had been solved by the introduction of the carbon incandescent lamp, and Major Flood-Page devoted his energies to promoting the commercial utilisation of the new illuminant. He was instrumental in introducing the first incandescent electric light into Australia, and then became secretary and manager of the Edison and Swan United Electric Light Co., Ltd. In the later years of his life he was interested in wireless telegraphy, and his faith in the ultimate success of this enterprise guided him through the many trials and difficulties which beset its path in the early days. Major Flood-Page first became actively engaged in wireless telegraphy in 1899, when he joined the Marconi Company in the capacity of managing director. In that year wireless telegraphy had advanced to a stage which permitted the establishment of communication across the Straits of Dover, between the Chalet d'Artois, Wimereux, near Boulogne, and the South Foreland lighthouse. He was one of a small party which waited at the wireless station at the Needles, Isle of Wight, in November, 1899, for the first wireless signals ever sent from a liner at sea to the British shores, and he was ever proud to recall the delight and satisfaction which he enjoyed as the liner's message was being received over a distance of sixty-five miles. After resigning the managing directorship, he remained a member of the board of the parent Marconi company and many of its leading subsidiaries. He died on April 7, in his eighty-second year.

SIR RUPERT CLARKE, who in the summer of last year led an expedition up the Fly River in British New Guinea, recently arrived in London to take up an appointment in the Army Service Corps. In 1890 Sir W. Macgregor reached a point 610 miles from the mouth of the river. Sir Rupert Clarke's expedition went 20 miles further. He also made the first ascent of Mount Donaldson, close to the German boundary. In a communication to the *Times* of April 10, he reports that the natives, a fine-looking, tall race, were at first inclined to be hostile, but later became friendly. They are divided into communes ranging in numbers from five or ten families to a thousand persons. No one is supposed to die a natural death, which is caused by suggestion through their magic men. After a man's death his relations must get a head so that his spirit may rest in peace. These heads are usually those of the women and children of hostile tribes. They are in constant fear of attack from their enemies, and live on scaffolds raised on high trees. Their bows are exceedingly formidable, beyond the strength of a white man to draw. They protect themselves from arrows by a kind of bamboo cuirass. They wear no other clothing. The height of Mount Donaldson was provisionally fixed at about 2000 ft. The return journey was effected in safety, without firing a shot, on rafts down the Fly River. Some signs of gold were discovered, but not rich enough to make working worth the trouble.

THE Royal Geographical Society has received news of Sir Aurel Stein's explorations in Central Asia from April to November, 1914. The expedition started in April from Tunhuang, where it had halted to recruit after the trying campaign in the Lop-nor desert between Turfan and the northern boundary of Tibet. The cave temples of the Thousand Buddhas near Tunhuang were re-visited, and further interesting collections were made. The explorer followed the ancient wall for 250 miles, and found that it was constructed of fascines of reeds or brushwood, admirably adapted to check the wind erosion of the desert sands. Coins, pottery, and metal fragments found near the surface made it possible to define the Chinese frontier posts with accuracy. Beyond the So-lu Hu valley further remains of the same kind were found. While Sir Aurel Stein was hunting for remains of the Great Yuechi on Indo-Hun culture to the north, his surveyor, Lal Singh, examined the ruined town of Khara Khoto, and proved that this could be no other than Marco Polo's "City of Etzina," where in ancient times travellers bound for Karakoram, the old Mongol capital, used to lay in supplies for the march across the great desert. Here many Buddhist remains were found, and it was ascertained that the ruin of the city was due to failure to maintain the irrigation system. When he despatched his report Sir Aurel Stein had planned to examine Buddhist ruins round Turfan, while his surveyor was to undertake the exploration of the little-known desert ranges of the Kuruk-tagh between Turfan and the Lop-nor depressions.

A SYSTEMATIC paper on Termites from the East Indian Archipelago, by Masamitsu Oshima, has been published in *Annotationes Zoologicae Japonenses* (vol. viii., part 5). Of the twenty-four species enumerated, nineteen are described as new to science. The author imitates many modern American entomologists by illustrating his new species with photographic figures, most of which are valueless for the purpose of identification.

IN the April number of the *Entomologists' Monthly Magazine* Mr. J. T. Wadsworth records the occurrence at Northenden, Cheshire, at the roots of cabbages, of the larvæ of an anthomyid fly (*Phaonia trimaculata*) new to the British fauna. Several of the grubs pupated, and eventually developed into the perfect insect, which measures 16 mm. across the extended wings—a fact rendering it somewhat remarkable that such a comparatively conspicuous species had not previously been observed in this country.

MANY English-speaking naturalists who attended the meetings of the International Entomological Congress at Brussels and Oxford remember with pleasure conversations with a courteous and enthusiastic Spanish priest, the Rev. P. Longihos Navas, S.J., whose good knowledge of French made him a valuable interpreter to his compatriots. We have received a little "Manual

del Entomologo," written by Father Navas, and published last year by the Catholic Press of Barcelona. It contains concise directions to the beginner for collecting, preserving, and classifying insects. Neither old nor new methods have been overlooked, for a well-worn figure of a collector "beating" into a venerable type of umbrella faces a sectional drawing of the modern "Berlese funnel."

DR. ROLF WITTING continues to contribute a great deal of most valuable hydrographical information on the sea-waters in the neighbourhood of Finland. In addition to the *Jahrbuch*, 1913, of the *Finländische Hydrographisch-Biologische Untersuchungen*, No. 13, which contains the details of salinity, temperature, and current measurements obtained on the seasonal cruises and at particular stations, we have received special papers by him on the optical and chemical examination of the water samples and on the methods of determining traces of ammonia in sea-water, as well as a paper by Prof. K. M Levander on the plankton of the Tavastfjärd. The oceanographers of Finland are to be congratulated on the regularity and persistence with which this work has been maintained for a number of years upon a uniform plan, a persistence which has obtained for them a place in the forefront of the European countries which have been engaged in marine researches in recent years.

WE have received from the British Museum (Natural History) a report by Dr. S. F. Harmer on Cetacea stranded on the British coasts during 1914. The arrangements made by the Board of Trade for reporting such strandings a couple of years or so ago have been continued, and in some respects amplified, a notable innovation being the dispatch of the lower jaws of the smaller species, and of a plate of whalebone in the case of the baleen-whales. Up to the outbreak of the war returns were received regularly, but afterwards, when coastguards had their hands full of other duties, there was a great falling-off in the returns, this being particularly the case during the period from August to mid-October, when the items should have been at their maximum. The whole annual record of strandings amounted only to fifty-seven, as compared with seventy-six in the previous year. It may now be regarded as definitely established that the porpoise is by far the most abundant of the smaller cetaceans visiting the British coasts, and it may be added that the series of lower jaws of this species received at the museum has enabled Dr. Harmer to make some valuable observations with regard to the rate of growth, wear, and variation of the teeth—such observations indicating that a so-called species founded on such differences is invalid. Four records of the dolphin and the same number of the white-beaked dolphin are included in the list, which also comprises a Sowerby's beaked whale taken alive in September on the Wexford coast.

A RECENTLY published number of the *Indian Journal of Medical Research* (vol. ii., No. 3) begins with a memoir by Mrs. Helen Adie on the sporogony of *Haemoproteus columbae*, the "halteridium" parasite of the blood of the pigeon. The development was studied in *Lynchia maura*, the hippoboscid fly which is a common parasite of pigeons, and well known to be the invertebrate host of the Hæmoproteus. Whereas, however, previous investigators had not been able to find any stage of the parasite more advanced than the "ookinete" or "vermicule" in the Lynchia, and were of opinion that the parasite was inoculated into the pigeon by the fly in this phase of its development, Mrs. Adie has found that the ookinete-stage is succeeded by a process of sporogony exactly similar to that of the malarial parasites, with oocyst and sporozoite stages, ending with vast numbers of sporozoites in the salivary glands of the fly. The author states that no blood-parasites other than the Hæmoproteus were to be found in the pigeons; this statement, if correct, disposes of the obvious criticism, that the sporogony seen might be that of some Proteosoma parasite of the birds. Mrs. Adie is much to be congratulated on having filled an important gap in the knowledge of the development of these parasites, and on having discovered a series of stages which had escaped the notice of such competent observers as the Sergent brothers and Aragao. It is to be regretted that all recent writers on the development of malarial parasites use the term "zygote" in an entirely incorrect manner; the term should be used to mean the body formed by the union of the two gametes, and should therefore be applied, in the present case, to the rounded stage preceding the ookinete, and not to the oocyst-stages following the ookinete-stage.

ATTENTION may usefully be directed to a paper on the care of old trees, illustrated by plates, in the *Kew Bulletin* (No. 2, 1915), since this is a subject often sadly neglected by those in charge of our parks and gardens which contain historic or interesting trees. The questions of breakages by wind, injuries by fungi, proper watering, feeding, and mulching, and the proper treatment of wounds are dealt with fully.

MR. T. PETCH contributes to the Annals of the Royal Botanic Gardens, Peradeniya (No. vii., vol. v.), a useful preliminary note on the genera Hypocrella and Aschersonia, fungi parasitic on scale insects which he has studied in connection with the type specimens preserved in the principal European herbaria. As a result of his investigations Mr. Petch has been able to clear the ground for his full paper, to be illustrated, we hope, with the drawings, by setting out the synonymy of the species examined. The species of the western hemisphere, with the one exception of *Hypocrella camerunensis*, found in Brazil and Africa, are distinct from those of the eastern hemisphere.

THE description of new species of plants from China occupies the greater part of No. xxxviii. of vol. viii. of the Notes of the Royal Botanic Garden, Edinburgh, and are largely the result of Forrest's and Ward's collecting in western China. Among them are six new Rhododendrons to swell the long list of this important Chinese genus, and one of them, *R. Wardii*, W. W. Smith, with its large flowers, "slightly fleshy bright yellow with the faintest touch of crimson on interior at base," fills the heart of the cultivator with

an eager desire to introduce the species. Messrs. Lace and Smith also describe three Rhododendrons from Indo-Burma, two of which were previously but very imperfectly known; all three species are figured.

THE *Kew Bulletin*, No. 2, 1915, contains several papers dealing with systematic botany and matters of general botanical interest. *Diospyros ebenaster*, a widely cultivated tree in the tropics, often considered to be a native of the Philippine islands, is almost certainly indigenous in the West Indies, whence it has been introduced to other countries at a very early date. Mr. Sprague enumerates the sections of the South African species of Loranthus, the outcome of his work on the genus for the "Flora Capensis," and there are descriptions of twenty new plants, ten from Africa and ten from Australia, India, Malaya, etc. Of more general interest is a paper on the germination of coco-nuts, with reference particularly to the age of the trees from which seed nuts should be taken. There appears to be no reason, especially in the light of recent experiments in the island of Nevis, why nuts from good trees in their third year of bearing should not be used despite the prevalent beliefs usually held on the subject that to use such nuts is to court disaster. The doubts entertained recall the words of Sir Thomas Browne: "So these Traditions how low and ridiculous soever, will find suspition in some, doubt in others, and serve as tests or trials of Melancholy and superstitious tempers for ever."

THERE are few better Transactions than those of the Norfolk and Norwich Naturalists' Society, and their high place in science is well maintained by their latest publication, vol. ix., part v., 1913–14. The work in this goodly volume of some 200 pages is admirable: and we think that the members of the society receive a full return, or more than full, for their subscriptions. We would also congratulate the hon. secretary, Dr. Sydney Long, on the care which he has given to the editing of the volume. The president of the society, Miss Alice Geldart, in her address to the annual meeting, announced that the society has published the "Flora of Norfolk," edited by Mr. W. A. Nicholson. The subject of her address was the lives of some of the earlier Norfolk botanists; and it is a model of careful and sympathetic biography. Next comes Mr. Wormald's paper, well illustrated, on the courtship of ducks; then the valuable reports on that sanctuary of birds and of wild plants, Blakeney Point. Other monographs, of no less value, are contributed by Dr. Brenchley, Mr. Burrell and Mr. W. G. Clarke, and Mr. Rivière; and there is a wealth of shorter papers. Altogether, the volume deserves the highest praise as the publication of a county scientific society.

MR. E. MANCINI contributes an account of the Italian earthquake of January 13 to the *Revue générale des Sciences*, etc. (March 15, pp. 146–48). Most of the details contained in it have already appeared in our columns (vol. xciv., p. 565; vol. xcv., pp. 76–7). Mr. Mancini remarks that the exact position of the epicentre is still undetermined, but that, according to Dr. Agamennone, there may have been two separate foci in action at, or nearly at, the same time (see NATURE, vol. xciv., p. 565). He estimates the total number of lives lost at more than 25,000. The number of persons saved at Avezzano was 2300 out of 13,000, so that the death-rate in that town must be reduced to 82 per cent.

A BIOGRAPHICAL notice of the late Prof. Adolfo Venturi appears in a recent number of the *Rendiconti della R. Accademia dei Lincei* (vol. xxiv., 1915, pp. 277–83). Born at Florence on September 22, 1852, he studied mathematics in the University of Pisa, obtaining his diploma in 1875. Shortly afterwards, he became mathematical teacher in the lyceum of Como, and in 1888 was appointed to the chair of geodesy in the University of Palermo. His work while at Como dealt mainly with the motion of the earth about its centre of gravity and the perturbations of comets and minor planets. At Palermo, he naturally turned his attention to geodetic problems, and afterwards to terrestrial refraction. Prof. Riccò in 1896 had begun a gravimetric survey of eastern Sicily, and this was extended by Venturi to the western half of the island. After a brief illness, Prof. Venturi died at Palermo on December 28, 1914.

MESSRS. EDWARD STANFORD, LTD., have issued Nos. 11 and 12 of their series of war maps. No. 11 shows the eastern theatre of operations, and includes Hungary, Galicia, Bukowina, Poland, and parts of the neighbouring areas. The map is on a scale of eighteen miles to the inch, and shows contours coloured on the layer system, which demonstrate clearly the Carpathian heights between the northern plain in Poland and the plain of Hungary. Railways, roads, rivers, and numerous towns and villages tend to facilitate reference in connection with the official *communiqués*. This very useful publication is 33×45 in. in size, and the price ranges from 7*s*. 6*d*. to 17*s*. 6*d*., according to style of mounting. No. 12 is devoted to the Dardanelles area of conflict; the sheet includes seven separate maps. There are plans of Constantinople, Smyrna, and Skutari; large-scale maps of the Dardanelles from Kum Kaleh to Gallipoli, and of the Bosphorus; a map of the Sea of Marmora and its entrances, and a map of Turkey-in-Europe and the western portion of Asia Minor. The two latter maps show contour at intervals of 1000 ft., and indicate relief by colour shading.

SCIENTIFIC PAPER No. 239 from the Bureau of Standards contains a description of a vibration electrometer by Mr. H. L. Curtis, of the bureau. The needle of the instrument consists of a light aluminium vane, 2 cm. square, supported with its plane vertical by a bifilar suspension, which extends both above and below the vane. Two fixed plates, 1×2 cm., are placed on each side of the vane, with their planes also vertical. The distances of the plates from the vane can be varied from 0·5 to 1·0 mm. To obtain complete control of the damping the whole instrument is enclosed in a bell jar which can be exhausted. The vane is connected to a battery giving 240 volts, and the alternating electromotive force to be detected is applied to

the plates, which are cross connected, as in the quadrant electrometer. Resonance is secured by adjusting the tension or length of the suspension, and the deflections are read by the telescope and scale method. With the air pressure reduced to 0·005 mm. of mercury the deflection per volt at 50 cycles per second is 6 cm. on a scale at a metre distance, and the least current the instrument will detect is 10^{-11} ampere. The behaviour of the electrometer agrees very closely with the theory developed by the author.

TECHNOLOGIC PAPER No. 41 of the Bureau of Standards, Washington, by R. S. McBride and J. D. Edwards, deals with the lead acetate test for hydrogen sulphide in illuminating gas, and is of interest here, as sulphuretted hydrogen is now the only impurity in coal gas officially controlled. It is pointed out that the various modes of testing in use are not all directed to the same end, since some of the tests are designed to detect as small traces of hydrogen sulphide as possible, while others aim to give a negative test when a permissible amount is not exceeded. The previous work of W. J. Dibdin and R. G. Grimwood, R. Forbes Carpenter, and C. J. Ramsburg, is described and criticised, and details of a new set of experiments are given in which some of the errors ascribed to the earlier work are avoided. The variations due to the kind of paper, concentration of lead acetate solution, preparation and condition of the paper, humidity of the gas, rate of flow and time of exposure, and the various forms of testing apparatus have been studied separately. Based on these results a method is recommended for use which is claimed to be quick and convenient, and gives reproducible results.

A RECENT publication among the Oxford pamphlets is by Prof. J. O. Arnold, the professor of metallurgy in the University of Sheffield, entitled "British and German Steel Metallurgy." It was inspired, as the opening sentences show, by an article by Prof. Rein, of the University of Vienna, on "Civilisation and 'Kultur.'" The pamphlet attempts to show (1) that German steel metallurgy owes far more to British inventors than British steel metallurgy owes to German inventors, and (2) that the steel department of the University of Sheffield has done work greatly superior to that of the corresponding department at Charlottenburg. The following claim bearing on the latter thesis may be quoted from the pamphlet as typical of the style:—"There are about twenty-nine constituents or sub-constituents of steel and iron. Of these, twenty-six have been discovered in Sheffield, the steelopolis of Great Britain; three in Middlesbrough, its ironopolis; and the record of Charlottenburg in this branch of research is absolutely blank." We confess to regretting that the author has by this publication placed himself in the category of those who desire to minimise the debt that British science owes to German science. It would have been better if the task had not been attempted.

THE *Engineer* for April 9 directs attention to some absurd British methods of dealing with drawings received from consulting and other engineers on the Continent. In a recent instance, detail drawings received from abroad showed particulars all dimensioned metrically. The British drawing office, with much care, translated these dimensions into feet, inches, and fractions. Some typical examples of the results are noted: A bolt circle diameter of 418 mm. was translated to $16\frac{7}{16}$ in. + $\frac{1}{64}$ in.; 21 mm. clearance holes for black bolts became $\frac{13}{16}$ in. + $\frac{1}{64}$ in. The chances of mistake in this method are considerable, and include translation errors, errors in ordering drills to such odd sizes, and errors in marking off and making jigs and templates. In addition, trained mechanics have an ingrained fear of dimensions in sixty-fourths, and will spend much more time over these figures than over even numbers. The commonsense method is to give the workmen the drawings in metric system and supply them with metric rules. In view of the continually increasing demand from the Continent for material manufactured in this country, it is probable that we are on the eve of a very considerable extension of the use of the metric system in our workshops and factories.

THE ninth report of the Royal Commission on Sewage Disposal has now been issued. Part ii. consists of a brief statement relating to the disposal of sewage in rural areas where sewers are not available. The question as to whether a rural committee should adopt some dry method of disposal, or provide sewers and purification works, depends upon whether a water supply is laid on to the houses or not. If it is, a sewerage system is almost inevitable; but if not, then dry closets may be used satisfactorily under proper supervision. In a minority report on this subject Sir William Ramsay appears to favour the extension of dry systems, even when a water supply is laid on to houses, mainly on the ground that the valuable nitrogen of domestic sewage ought to be returned to the soil. *Engineering* for April 9, commenting on the report, sympathises with Sir William Ramsay's desire to put some check on such a waste; but points out that epidemic disease amongst the people involves a greater waste, and there is no denying the beneficial effects on health which follow the acquisition of a pure and abundant water-supply, or the evils which, literally, lie at the door of ill-managed "dry" systems.

OUR ASTRONOMICAL COLUMN.

COMET 1915*a* (MELLISH).—The following ephemeris of Comet Mellish is a continuation of that calculated by Messrs. Braae and Fisher-Petersen, and printed in a circular issued by Prof. Elis Strömgren:—

	R.A. (true) h. m. s.	Decl. (true) ° ′ ″	Mag.
April 20 ...	18 24 59	... −5 36·0	
22 ...	27 6	... 6 13·6	... 7·6
24 ...	29 12	... 6 54·4	
26 ...	18 31 18	... −7 38·8	... 7·4

The comet is moving in the constellation of Aquila, and lies to the west of λ Aquilæ and is about equi-

distant from η Serpentis, which star is further to the westward.

THE CHROMOSPHERIC SPECTRUM WITHOUT AN ECLIPSE.—In the March number of the Proceedings of the U.S. National Academy of Sciences, W. S. Adams and Cora G. Burwell describe briefly the results of an investigation of the flash spectrum without an eclipse in the region λ 4800 and λ 6600. The full paper will soon be published as No. 95 of the *Contributions from the Mount Wilson Observatory*. In the first place, it is interesting to record that the total number of lines measured upon the negatives taken without an eclipse is greater than that obtained from eclipse negatives. Thus Mitchell's beautiful chromospheric spectrum of 1905 showed 901 lines, while those here measured number 1027 lines. It is further pointed out that in the photographs taken without an eclipse the wave-lengths of the bright lines have been determined with reference to the dark lines at the limb. A comparison of 512 lines shows that the difference between the wave-lengths of the bright lines and the dark lines at the limb gives a value −0·002 Angstrom. The preponderance of the negative sign in the case of the individual elements makes it fairly probable that this quantity may be regarded as real. Reference is made also to the marked gain in accuracy for the Mount Wilson results, attributed notably to the greater linear scale of the photographs. Some peculiar characteristics of the dark line spectrum of the sun's limb as seen on the photographs of the flash spectrum are briefly decribed, and the identification of the elements to which these lines belong is suggested as a research of decided interest.

THE ROTATION OF NEBULÆ.—Prof. Percival Lowell has forwarded two very interesting photographs of the spectra of nebulæ taken by Dr. V. M. Slipher, both of which are briefly described by the latter. The first is the spectrum of Virgo nebula, N.G.C. 4594, taken in April, 1913, with an exposure of 30 hours, together with comparison spectra of vanadium and iron. It was from this photograph and two others, also taken in the same year, all of which showed the nebula lines inclined, that the first direct evidence that nebulæ rotate was secured. In the photograph sent the slit was placed east and west, and the rotation in the sense that brings the west side of the nebula towards the earth. In addition to their inclination the lines have a large displacement, which makes the solar band G nearly coincident with the iron line λ 4326, thus indicating a velocity of recession of 1100 kilometres. Dr. Slipher remarks that this was far the highest velocity then known, but "further observations of nebulæ here have revealed others as high." The second photograph is of the spectrum of the Crab nebula, N.G.C. 1952, taken in February of the present year, with 18 hours' exposure, and similar comparison spectra. This is described as "the most remarkable nebula spectrum known." Upon a rather strong continuous background are found bright lines typical of gaseous nebulæ lines. Thus the lines $\lambda\lambda$ 5007, 4959, 4861 (Hβ), 4686, 4341 (Hγ), seem to be present. The strange appearance of these bright lines is described as follows:—"They seem to be split into doubles, best seen in λ 5007 and λ 4861 (the inside components of λ 4959 and λ 5007 would be blended). The distance between the components changes with the position in the nebula. It reminds one of the Zeeman effects in a non-uniform magnetic field and implies the origin to be within the atom. However, the maximum separation is quite enormous—40 tenthmetres. A plausible explanation of the spectrum as velocity effects has not occurred to me as yet."

THE "SCIENTIFIC AMERICAN" AND ASTRONOMY.—The Paris Observatory and its work is the subject of an interesting article to the *Scientific American* (March 13) by Prof. G. A. Hill, of the United States Naval Observatory. The author accompanies his text with two excellent reproductions showing the large transit circle and the eye end of the equatorial Coudé. The history of this famous institution is briefly sketched, and special reference made to the lunar photographs taken by MM. Loewy and Puiseux. In the issue of the same journal for March 20, Abbé Th. Moreux describes the planet Saturn, its ring system, and the satellites, and accompanies his remarks with a large number of reproductions from early and late drawings. Such articles popularly written and finely illustrated render a great service in disseminating astronomical knowledge, and we hope to direct attention to similar contributions in future issues.

EXPERIMENTAL STUDY OF THE MECHANISM OF WRITING.

OF recent years considerable advances have been made in the experimental study of the complex processes of reading and writing, mainly in the interests of a new experimental science, which is at present calling itself "experimental pedagogy," and at recent meetings of the British Association the Educational Science Section has devoted a good deal of attention to such work. In the Proceedings of the Royal Society of Edinburgh a further contribution to the experimental analysis of the writing process is made in a paper by Mr. James Drever, on the analytical study of the mechanism of writing.

Looked at from the outside, and regarded purely as a mechanical process, the writing act consists of certain movements and co-ordinations of movement of the fingers, hand, forearm, and shoulder. Of these the hand movements and the work of the fingers are the most important. By employing various pieces of comparatively simple apparatus it is possible to separate hand and finger movements, as well as to isolate for observation and study both the pressure of the fingers in holding the writing instrument and also the pressure placed upon the writing point.

To Prof. C. H. Judd, of Yale, we owe the original idea of a simple piece of apparatus which enables the experimenter to separate hand and finger movements. This apparatus consists essentially of an attachment for the fifth metacarpal, which carries a pencil or style for recording the movement of the hand. The original form of the apparatus was defective in several respects, but a modified form described in the above-mentioned paper seems to eliminate most of these defects. By comparing the record of the hand movement with the actual writing we can determine the part played by finger movement. It should be noted, however, that there is one movement of the hand in writing which cannot be recorded in this way. That is the movement known as pronation—the movement round the axis of the wrist.

Records taken with Judd's apparatus yield several interesting results. Some writers use little, if any, finger movements, and most writers, when writing at maximum speed, and especially with the pencil, approximate to this type. Ordinarily, however, in careful adult writing in this country, all the finer work in the formation of the letters is due to finger movement, and this to a greater extent in pen writing than in pencil writing. As a rule the writers themselves are quite unconscious of such finger movements. In the writing of the child, who

is merely at the learning stage, there is little finger movement, but finger movements develop as facility is acquired.

The isolation of grip pressure in writing is secured by an apparatus consisting essentially of a double-walled rubber capsule, inserted into the pen or pencil holder to take the grip (Fig. 1). The space between the walls, and also the inner space, are filled with mercury. A capillary glass tube passes into the inner space, and its top is connected by means of rubber tubing in the usual way with a recording tambour. Any variations in pressure on the outer wall of the capsule are in this way transmitted to the tambour and graphically recorded by the marking lever on a smoked drum.

FIG. 1.

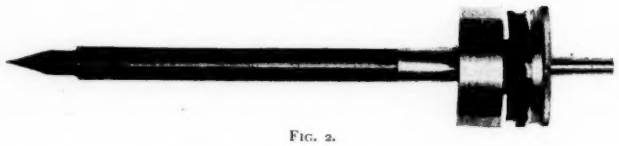

FIG. 2.

Very little work has hitherto been done in the study of grip pressure. The most striking feature in the grip pressure curve obtained is its rhythmical character (Fig. 3, VI). With the adult this rhythm is extremely regular, but it is absent in the earliest writing of children, first appearing about the age of eleven, and then with marked irregularities (Fig. 3, VII.). In writing with the pencil the grip pressure is considerably greater than in writing with the pen, and the difference between maxima and minima in the rhythm also greater. Finally, there are in adult writing definite indications that a word or even phrase is written with one total impulse.

Several different forms of apparatus have been employed for obtaining a record of point pressure in writing. Continental investigators have employed a writing plate, either connected directly with a lever for marking on a smoked surface, or resting on an air cushion pneumatically connected to a recording tambour. In Mr. Drever's apparatus the pen or pencil is attached to a receiving tambour, which forms the top of the pen or pencil holder (Fig. 2). This last form of apparatus is exceedingly simple and convenient for use with children.

The study of the point pressure curve has already yielded some interesting results, which bear not only upon education but also on the study of mental defects. In normal adult writing two types of pressure curve were early and easily distinguished, and it is possible to distinguish three. The first, which is known as the masculine type, shows a single definite maximum of pressure for each word, and increased pressure with increased speed of writing (Fig. 3, IV.). The second, known as the feminine type, shows several maxima of pressure in each word, and diminished pressure with increased speed of writing. The third, which might be called the clerical or mechanical type, shows great uniformity of pressure in each word, and practically no change of pressure with increased speed of writing; further, there is comparatively little increase of speed beyond the ordinary rate, and in some cases the speed actually

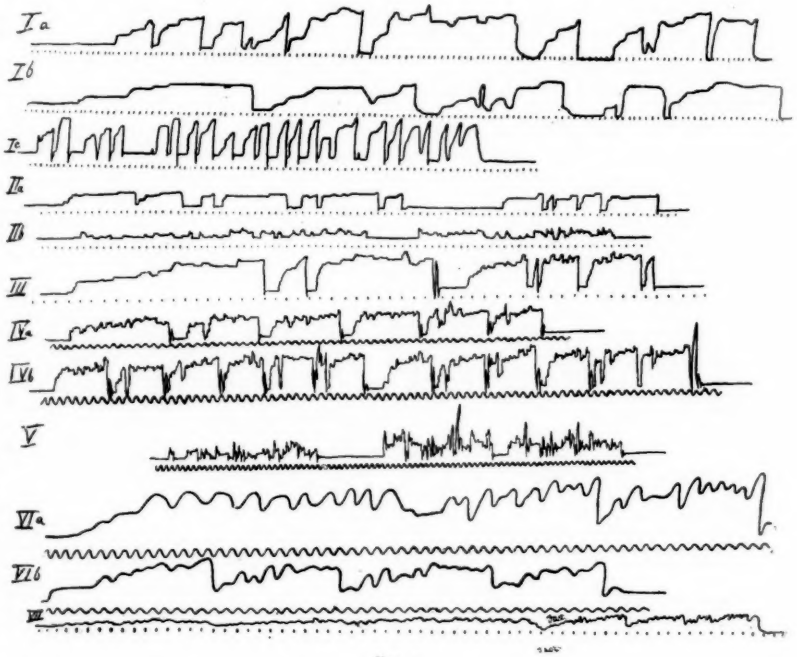

FIG. 3.

I. to III. Point pressure tracings from children. Time record in seconds by Jacquet Chronograph.
I*a*. Child of six. Words "The cow gives us milk."
I*b*. Child of six (first attempt at script). Words "A man can."
I*c*. Child of six (printing). Words "A man can run"
II*a*. Pencil writing, and II*b*. Pen writing of child of eight. Words "Moray House School," written twice in each case.
III. Child of eleven. Pencil writing. Words "Moray House School," written twice.
IV. and V. Point pressure tracings from adults. Time record in ⅕ secs. by vibrating spring.
IV*a*. Pencil writing, ordinary rate. Words "Moray House School," written twice.
IV*b*. Pencil writing by same subject, maximum rate. Words "Moray House School," written four times.
V. Pen writing, slow and fast. Words "Moray House School," written once slow and twice fast.
VI. and VII. Grip pressure tracings from adults and child of eleven. Time records for adults in ⅕ secs. and for child in secs.
VI*a*. Adult pencil writing. Words "Moray House School."
VI*b*. Adult pen writing. Words "Moray House School Moray."
VII. Child's pencil writing. Words "Moray House School" twice, slow and fast.

diminishes, while the subject thinks he is writing faster.

The pressure curves obtained from children differ from all the adult types. A flat-topped curve had been considered until recently the characteristic child's curve (Fig. 3, II.*a*). This curve does not, however, represent the first stage in the acquiring of writing. The first curves obtained are more or less characteristically drawing curves (Fig. 3, I.). Such curves are best seen where the child begins with printed letters rather than script (Fig. 3, I.*c*). In this case each stroke requires a definite and separate impulse, and this is well marked in the pressure curve. In the earliest script the curve seems merely irregular, but this is due to variations in the drawing unit with which the child is dealing, which may be a single stroke, a letter, or a group of letters. The second stage in learning to write is marked by what was formerly called the child type of pressure curve, a curve with a strikingly regular, flat top, which is still a drawing curve, though the child is now drawing the whole word. This curve passes gradually into the curve with rippled top of adult writing, the time when the transition can really be said to take place being about the age of ten or eleven (Fig. 3, III.). The transition seems to mean two things. In the first place the necessary co-ordinations are established to such an extent that the mechanism of writing works without attention to the individual strokes and forms which the hand is making. In the second place, and partly because of this, writing has ceased to be drawing and has become language, the rhythmical variations in point pressure corresponding to the rhythmical variations in grip pressure, and being analogous to a certain extent to the rhythm of speech. When this stage is reached the impulse under the direction of which writing takes place is distinctly a word impulse, and sometimes even a phrase or sentence impulse.

It has also been found that the writing of defectives fails to show this characteristic rhythm of adult writing, while drugs like alcohol tend to impair the rhythm and ultimately to break it down altogether, apparently because of their effect on co-ordination. It is also somewhat interesting to find that the pressure curve is almost as characteristic of an individual as his signature, and persists even in left-hand writing without previous practice. There is evidently a wide field for investigation in this direction, and perhaps we may yet see the development of a real science of graphology based upon such investigation.

FLORA OF ADEN.[1]

PROF. BLATTER has brought together an interesting account of the vegetation of the Aden peninsula, in which, after summarising the history of botanical exploration of this region from the earliest times, he gives data regarding physiography, climate, soils, tabulated lists of the plants, and brief notes on their distribution, origin, means of dispersal, etc. No references are made to work on plant ecology, but a comparison of the characters of the Aden vegetation with that of other arid regions, as investigated particularly by the Carnegie Institution botanical staff in North American and North African deserts, brings out some points of considerable ecological interest.

The first botanical description of Aden was given by Ibn Batuta in about 1330, and it consisted of the brief statement that "there are neither seeds nor trees nor water." Though Aden is not so entirely destitute of vegetation as this famous traveller supposed, the impression it produced upon much more recent botanical visitors was scarcely more favourable. Sir J. D. Hooker, in 1847, described Aden as being "upon the whole the ugliest, blackest, most desolate, and most dislocated piece of land, of its size, that ever I set eyes upon, and I have seen a good many ugly places"; but he mentioned the comparatively fertile lower valleys, thickly studded with beautiful-flowered shrubs and small trees. Prof. Blatter's compilation is based largely upon the scattered reports and collections made by residents and visitors, and shows that Aden, despite the fact that it consists largely of "bare naked rocks which cannot find their equal in any part of the world as regards dryness, infernal heat, and barrenness," possesses an interesting and surprisingly varied vegetation.

The volcanic rocks forming the greater part of the Aden peninsula, which is about fifteen miles in circumference, are practically devoid of plant life; even lichens are scarce on the sun-baked and disintegrating rock-surfaces. These lofty and jagged rocks, rising in places to 1700 ft. altitude, are scored by steep gulleys and mostly run straight down to the shore, but here and there the lower slopes are gentle or almost flat, and in such places the clayey soil retains rain-wash, which elsewhere quickly runs off or percolates through the loose soil, and the vegetation in these parts is fairly rich. Apart from such habitats, the rigorous character of the conditions with which the Aden plants have to contend may be realised from the facts that there are no permanent streams or springs or marshes or ponds; the annual rainfall rarely exceeds six or seven inches in the wettest years; no rain may fall for two years at a time, and when it does fall it usually comes down in a torrent lasting for a day or two, changing the dry gulleys into turbulent streams which quickly dry up again.

The Aden flora consists of 250 species of flowering plants, including ten trees, fifty-eight shrubs, forty-six undershrubs, and 136 herbs. The work of the Carnegie Institution botanists has shown that in the most arid regions of the earth, where the rainfall is extremely scanty, infrequent and irregular, what were formerly regarded as the typical desert-plants, namely, species with fleshy water-storing leaves and stems (cacti, etc.), are almost or entirely absent, and that the desert type *par excellence* is not succulent, but sclerophyllous. This term is applied to plants which do not store up water but contend with the extreme aridity of their environment by various adaptations for reducing water-loss to a minimum—reduced leaf surface, dense hair-covering, waxy cuticle, gummy epidermis, development of leaves or branches or both as spines, etc. From Prof. Blatter's list such plants appear to be dominant in the vegetation of Aden; fleshy species are practically confined to the sea-coast. A further point of interest is that about half of the herbaceous plants listed for Aden are short-lived annuals, which grow in the clayey soil of the flats and gentle slopes where water can be retained in the surface layers long enough for these plants to complete their brief life-cycle whenever rain comes. This, again, is a characteristic feature of the typical desert flora with clayey oases.

The records of the Botanical Survey of India contain so much that is, at any rate potentially, of general interest to students of plant ecology, that while the material they contain is welcome and useful, it is much to be hoped that the survey workers will make themselves acquainted with what has been and is being done on modern ecological lines, so that they may

[1] "The Flora of Aden." By Ethelbert Blatter, Professor of Botany at St. Xavier's College, Bombay. Records of the Botanical Survey of India. Vol. vii, No. 1. Calcutta, 1914. Pp. ii+79; 5 plates; 1 map.

correlate their results with those obtained in other regions by the application of methods which alone can make a botanical survey what it is now generally expected to be—a correlated study of the plant communities and the plant habitats of the area surveyed.

F. C.

ORNITHOLOGICAL NOTES.

AT the annual meeting of the Royal Society for the Protection of Birds, held at the Middlesex Guildhall, on March 11, when the Ranee of Sarawak presided, an optimistic tone prevailed in the first portion of the report for 1914, as several of the schemes and objects for which the Society had long been labouring were apparently on the point of realisation. Then came the war, when all these fair prospects—particularly the expected passing of the Government Plumage Bill—were dissipated, to be renewed, it may be hoped, at the conclusion of the war. In other respects the work of the Society was, on the whole, satisfactory; but finance is a matter on which there is serious ground for anxiety, as a falling-off in subscriptions during the current year is almost inevitable.

The condor forms the subject of the first article in the March number of the *Children's Museum News*, where particular reference is made to the long period taken by these birds to attain the adult plumage. Hatched during the height of the southern summer, the young exchange their white nestling dress for a uniformly brown garb, which is not finally discarded until the seventh year, in February or the early part of March. Although able to fly when a year old, young condors do not leave their parents until the completion of their third year.

In the course of a wonderfully illustrated article on a breeding-colony of buff-backed herons, published in the March issue of *Wild Life*, Mr. B. Beetham directs attention to the small size of the nests of these birds, which alone renders it possible for so many to be crowded into a single bush. So heavily weighted, indeed, are some of the boughs that they hang almost vertically; and it is little short of marvellous how the eggs and young are retained in the shallow, cup-like nests, generally overhanging a lagoon, into which the hapless offspring may be precipitated by a gust of greater strength than usual. The nests are devoid of lining, and in some cases so flimsy in structure that the pale blue eggs are visible from below.

The nesting-habits of fulmar-petrels on a precipitous cliff in the Orkneys form the subject of an article by Mr. O. G. Pike in *British Birds* for March. The author arrived on the scene in the second week in July, when most of the young were hatched; but he was able to secure a couple of photographs of sitting birds, as well as one of a downy nestling. Each female lays but a single egg, and at a very early stage the young bird is capable of indulging in the distinctly petrel-trait of discharging a forceful jet of evil-smelling green oil from its mouth in the face of a real or supposed enemy.

To the Journal of the Straits Branch of the Royal Asiatic Society for December, 1914, Mr. J. C. Moulton, curator of the Sarawak Museum, contributes a list of Bornean birds. In an appendix to Hugh Low's "Sarawak," published in 1848, the number of species then recognised was fifty-nine; this was raised in 1889 in a list drawn up by the late Mr. A. H. Everett to 536 (exclusive of thirty-four from Palawan), while in the present list the number is again augmented to 555; and this, too, despite the fact that several birds formerly regarded as distinct species have been relegated to the rank of local races.

According to the report in the January number of the *Emu*, the fourteenth annual session of the Royal Australasian Ornithologists' Union, held in Melbourne in November, 1914, was a thorough success, a number of interesting excursions being taken and several papers read. In the same issue Mr. A. J. Campbell directs attention to the apparent extermination of three beautifully coloured species of parrots—namely, the scarlet-shouldered *Psephotus pulcherrimus*, the chestnut-shouldered grass-parrot (*Euphema pulchella*), and the night-parrot (*Geopsittacus occidentalis*), all of which were to be met with a few years ago in Queensland or the neighbouring districts. Their disappearance is attributed to domesticated cats run wild, aided by bush-fires and the spread of cultivation.

In the *Zoologist* for March, Prof. J. C. Patten describes an immature aquatic warbler picked up at Tuskar light-station, County Wexford, on August 9, 1913. The paper is illustrated by a plate showing how the plumage of this species differs from that of the sedge-warbler at the same age. In the aquatic warbler the back is marked by streaks of black and buff, which are but slightly developed in the sedge-warbler; both webs of the middle pair of tail-feathers are also margined with buff, and all the tail-feathers are likewise longer, narrower, and more pointed than those of the sedge-warbler. The Tuskar bird is the second of its kind taken in Ireland; the number of specimens recorded from Great Britain (England) is seventeen.

R. L.

MOUNTAIN GEOLOGY.

IN the *Mémoires de la Société de Physique et d'Histoire Naturelle de Genève* (vol. xxxviii., pages 69–168) M. Louis Duparc and Mme. M. Tikanowitch continue their work on the Ural Chain by an account of its rocks to the east of the main watershed and in the upper basin of the rivers Kakwa and Wagran. This, the fourth of their contributions to the geology of that chain, is prefaced by a sketch of the physical features of the district, the illustrations to which show that it consists of huge hills rather than of rugged mountains. The rocks are partly sedimentary, arenaceous, or slaty argillaceous, with some quartzose crystalline schists; partly igneous. Of the latter a very complete petrographical study has been made, including chemical analyses of the principal types, several of which are very interesting. Among those of deep-seated origin are the following: quartz-bearing micaceous diorites (evidently allied to tonalites) and gabbro-diorites (in which probably the hornblende is secondary), olivine-gabbros, and massive dunites. Besides these and serpentines, are tilaite (a variety of eucrite) and pyroxenites. This association is interesting, for it often exists, more or less completely, in other regions, and suggests certain modes of magmatic differentiation. The dyke-rocks include hornblendic berbachites and various dioritic porphyrites, besides amphibolites, in some at least of which the hornblende appears to be secondary. The article ends with a description of the crystalline schists which, however, do not appear to be of any unusual interest. The memoir, illustrated by twelve photographic figures of the microscopic structure of the more interesting rocks, forms a most welcome addition to petrology, the more remarkable when we learn the difficulties with which the authors had to contend in their three visits to this region, in consequence of the sparse population, the want of roads, and the absence of maps.

In the next fascicule (pp. 169–98) M. Jules Favre describes the relation of the plant-life to the geology

of the Salève. This mountain, which rises about 3000 ft. above Geneva, consists of limestones and shales (Upper Jurassic and Neocomian), with Middle Tertiary sandstones, chiefly molasse, and glacial deposits. Apart from the effects of altitude, the flora is much affected by the nature of the rock on which it grows, and besides this, a small colony of special plants generally accompanies any local physical peculiarity. Of this association the large erratics of Alpine granite and schists afford a remarkable instance. *Asplenium septentrionale* is the only phanerogamous plant found on them to which rocks, in the High Alps, it is practically restricted.

BLOOD-PARASITES AND FLEAS.

FOR the past five years Prof. E. A. Minchin and Dr. J. D. Thomson have been engaged upon the investigation of the rat trypanosome, *Trypanosoma lewisi*, with special reference to its relation to the rat flea, *Ceratophyllus fasciatus*. The results of this laborious and painstaking research are now published in the *Quarterly Journal of Microscopical Science*. They form a comprehensive monograph which occupies the whole of the last part of this journal (vol. lx., part 4) and will undoubtedly be a standard work of reference for students of these very important blood-parasites. The fact that the authors have dissected and examined more than 1600 fleas in the course of their investigations shows the thoroughness with which the work has been carried out, while the artistic treatment and accuracy of detail contributed by the illustrations, for which due acknowledgment is made to Miss Rhodes, leave nothing to be desired. *T. lewisi* is fortunately a non-pathogenic parasite, at any rate so far as the rat is concerned, and it cannot live at all in human blood. It therefore forms a much more suitable type for general study than such deadly species as those which are conveyed by the tsetse-fly in Africa, and are responsible for fly-disease amongst horses and cattle, and for sleeping sickness in human beings. The authors give a very useful account of the technique employed in their investigations, and, incidentally, throw a good deal of light upon details of the anatomy and histology of the flea.

The flea, of course, receives the parasite with the blood which it extracts from the rat, but apparently it cannot infect the rat by inoculating trypanosomes into it through the proboscis. The rat is supposed to become infected through the mouth; in the process of licking its fur it takes in trypanosomes with fæcal matter deposited by the flea; or it may become infected by eating infected fleas.

While in the flea the trypanosome is confined throughout its whole development to the digestive tract, where it undergoes extensive asexual multiplication and passes through a number of more or less distinct phases, some of which are intracellular in the epithelium of the stomach. No sexual phenomena have been detected, and the authors agree with Miss Robertson that such phenomena have not as yet been satisfactorily demonstrated in the case of any trypanosome.

CHANGES OF RELATIVE LEVELS OF LAND AND SEA.

AMONG the different kinds of evidence showing that changes in the relative levels of sea and land are going on all over the globe, the forms assumed by coast-lines are now recognised by geologists as being the most convincing and satisfactory. Sea-erosion, acting only along shore-lines, and subaerial denudation, operating over the whole land-surfaces, result in features of such clearly differentiated character that no unbiassed observer can fail to recognise their great significance and value. When we find long, narrow, deep, and winding inlets from the sea into the land ("fiords," etc.), it is obvious that such features could not result from the cutting back of the coast-line by the sea, but that they are old river-channels that have been drowned by the sinking of the land. On the other hand, sea-beaches, with caves, fan-taluses, and other signs of shore work, occurring at various heights above the present sea-level, speak, quite as unmistakably, of elevation having taken place.

The illustrious American geologist, James Dwight Dana, when accompanying the United States Exploring Expedition under Wilkes, had the opportunity of visiting many coral-reef islands, and we are indebted to him for first showing, in 1849, the value of the evidence afforded by coast-lines, where bounded by "encircling" or "barrier" reefs, of subsidence having taken place. These valuable observations of Dana seem to have been almost completely overlooked until quite recent years, and it is only fitting that to a fellow-countryman of his should fall the task of recalling and developing this pioneer work.

Where a coral-reef encircles a land-mass it is evident that the presence of "fiords" or their equivalents in the central island supplies clear evidence of submergence having taken place, though possibly this may not be the latest of the movements that have occurred. On the other hand, the existence of islands composed of upraised coral-rock, with sea-caves and shore deposits at different stages, up to more than 1000 ft. above the present sea-level, supplies equally clear evidence of movements in an opposite direction having taken place. The late Prof. Alexander Agassiz published a very valuable series of reports, abundantly illustrated, concerning these upraised Pacific reefs, and we now have the promise of equally important descriptions by Prof. W. M. Davis, also of Harvard, of the cases in which the proofs of subsidences can be no less satisfactorily made out.

The general result to which these various observations appear to point is that, over the whole area of the Pacific, areas of elevation and others of subsidence can be clearly traced, though the movements were often interrupted and sometimes reversed; nevertheless, it must be admitted that in some cases the evidence seems puzzling and contradictory—islands with clear evidence of elevation lying in close proximity to others which have clearly subsided. Geologists will not, however, be unprepared for the occurrence of such seeming anomalies; they will only recognise that, eventually, actual fault-lines may be traced by such means in the oceanic areas. At the same time it may be well to bear in mind the caution suggested by Darwin in his correspondence with Semper that, however clear may be the evidence in favour of any special theory of coral-reef formation, we must be always prepared for the occurrence of special cases which can only be accounted for by the operation of exceptional causes. The full and complete account—which will no doubt be sufficiently illustrated—of Prof. W. M. Davis's important series of explorations will be looked forward to with special interest, and in the meantime the subjoined general summary of his results will be welcomed by all naturalists.

J. W. J.

Preliminary Report on a Shaler Memorial Study of Coral Reefs.

A liberal grant from the Shaler Memorial Fund of Harvard University, supplemented by a generous subsidy from the British Association for the Advance-

ment of Science, with an invitation to attend its meeting in Australia last August as a foreign guest, enabled me to spend the greater part of the year 1914 in visiting a number of islands in the Pacific Ocean with the object of testing various theories that have been invented to account for coral reefs. Thirty-five islands, namely, Oahu in Hawaii, eighteen of the Fiji group, New Caledonia, of which the entire coast-line was traced, the three Loyalty islands, five of the New Hebrides, Raratonga in the Cook group, and six of the Society islands, as well as a long stretch of the Queensland coast inside of the Great Barrier reef, of north-eastern Australia, were examined in greater or less detail. A brief statement of my results has been published in the Proceedings of the National Academy of Sciences for March, 1915. A full report upon my observations will appear later, probably in the Bulletin of the Museum of Comparative Zoology at Harvard College. The general conclusions reached are here briefly summarised.

Any one of the eight or nine theories of coral reefs will satisfactorily account for the visible features of sea-level reefs themselves, provided the postulated conditions and processes of the invisible past are accepted; hence a study of the visible features of the reefs alone cannot lead to any valid conclusions. Some independent witnesses must be interrogated, in the hope of detecting the true theory of their origin. The only witnesses, apart from sections obtained by deep and expensive borings, available for sea-level reefs are the central islands within oceanic barrier reefs, or the mainland coast within a continental barrier reef. The testimony of these witnesses has been too largely neglected, apparently because most investigators of coral reefs have been zoologists, little trained in the physiography of shore lines. Elevated reefs afford additional testimony in their structure and in the relation of their mass to its foundation; but this testimony also has been insufficiently considered, perhaps because most investigators of reefs have as zoologists been little trained in structural geology; hence it seemed desirable to give as much time as possible on the Pacific Islands to questioning the independent witnesses above designated.

The testimony of the first group of witnesses—the central islands of barrier reefs—convinced me that Darwin's theory of subsidence is the only theory competent to explain not only the development of barrier reefs from fringing reefs, but also the shore-line features of the central islands within such reefs; for the embayments of the central islands testify emphatically to subsidence, as Dana long ago pointed out; thus my results in the study of this old problem of the Pacific agree with those of several other recent students, especially Andrews, Hedley, and Taylor of Australia, and Marshall of New Zealand. Darwin's theory of subsidence also gives by far the most probable explanation of atolls; for it is unreasonable to suppose that a subsidence of the ocean bottom should occur only in regions where the central islands of barrier reefs are present to attest it, and not in neighbouring regions where reefs of identical appearance, but without a central island, are given another name.

The testimony of the second group of witnesses—massive elevated reefs such as occur on certain Fiji islands—convinced me that Darwin's theory of subsidence gives the only satisfactory explanation of the origin of such reefs also; for their limestones rest unconformably on the normally eroded surface of a pre-existent foundation. The erosion of the foundation surface shows that it stood above sea-level before the reef was deposited upon it; and the occurrence of the reef shows that the eroded foundation subsided to receive its marine cover. Only after this subsidence was the compound mass uplifted. The mere occurrence of elevated reefs above sea-level does not for a moment prove that they were formed during the emergence of their foundation.

All the still-stand theories of barrier reefs—that is, all the theories which involve a fixed relation of the reef foundation to the sea-level during the formation of the reef mass—are excluded by evidence of submergence found in the embayed shore lines of the central islands within barrier reefs. It may seem over-bold thus at a stroke to set aside several well-known theories, accepted by experienced observers; and so indeed it would be if these observers had discussed the features of the embayed central islands, and had explicitly shown that their embayments are not due to submergence but to some other cause. It is, however, a regrettable fact that the observers who adopted one or another of the still-stand theories took, like Darwin himself, practically no account of the embayed central islands, essential as the testimony of these islands is in the solution of the coral-reef problem. Such neglect is all the more remarkable in view of the clear statement, long ago published by Dana, regarding the pertinence and the value of the testimony afforded by the central islands of barrier reefs.

The glacial-control theory of coral reefs, recently elaborated by Daly with special reference to the lagoons of atolls, will not hold for barrier reefs. This theory assumes that no subsidence of the reef-foundations took place, and explains the lagoon floors of atolls as platforms abraded across pre-glacial sea-level reef-masses by the lowered and chilled sea of the glacial period after the corals were killed; the pre-glacial reef-masses having been formed by upward or outward growth on still-standing foundations. It then explains the encircling reefs which now surround the lagoons as having been built up while the sea was rising and warming in post-glacial time. But if the broad lagoons of large atolls twenty or thirty miles in diameter were thus formed, the central islands within narrow-lagoon barrier reefs should be cliffed all around their shore line, and they are not. Furthermore, this theory explains the embayments of central islands within barrier reefs as occupying new-cut valleys that were eroded during the glacial period of lowered sea-level; but if this were the case, the new-cut valleys should be prolonged upstream from the embayment heads as incisions in the floors of pre-glacial valleys, thus producing a "valley-in-valley" landscape; and this is not true in any one of the hundreds of embayments seen during the past year. Furthermore, many of the embayments are so wide that, if they were opened by slow subaerial processes, the spur-ends ought to have been well cliffed by the sea; yet, as above stated, they are not cliffed. Finally, many of the embayments are too wide to have been eroded during the last glacial epoch, or even during all the glacial epochs of the entire glacial period, if the valleys of the formerly glaciated volcanoes in central France are taken as standards of the amount of erosion that could be accomplished on such masses during such intervals of time. The glacial control theory thus proves incompetent to explain barrier reefs, and it is therefore held to be generally incompetent to explain atolls also; it may have more importance on the borders of the coral zone, where the corals would most likely have been killed during the glacial period: the Marquesas islands promise interesting results in this connection. The glacial-control theory has its greatest importance in conjunction with Darwin's theory of subsidence; for sub-

mergence during subsidence may have been almost neutralised by the lowering of the sea-level during the oncoming of a glacial epoch, and under such conditions coral reefs would broaden and lagoons would become shallow; but with the passing of a glacial epoch the return of ice-sheet water to the ocean would accelerate the submergence due to subsidence, and at such a time, coral reefs might be more or less completely drowned; thus the discontinuity of certain reefs on so-called "platforms" may be explained.

All the phenomena which testify to the formation of coral reefs on subsiding foundations can be equally well explained by the assumption of a rise of the ocean surface around or over fixed foundations; but a rise of the ocean surface in any coral-reef region demands a rise of the whole ocean surface; and if the coral-reef foundations are to stand still, a rise of the whole ocean surface can be explained only as the diminished result of a greater rise of the ocean floor in some non-coral-reef region. The conditions involved in this alternative for the simple theory of local subsidence are so extravagantly improbable that, as soon as they are explicitly defined, they must be rejected.

No absolute demonstration of the origin of coral reefs, or, for that matter, of any other geological structure, is possible; the most that can be hoped for is a highly probable conclusion. The conclusions announced above in favour of Darwin's theory are believed to have about the same order of probability as that usually accepted as "proof" in geological discussions.

A number of local conclusions may be briefly announced as follows:—

The elevated reef along the south coast of Oahu, Hawaii, was formed during or after a sub-recent period of subsidence, for its limestones enter well-defined valleys that must have been eroded when the island stood higher than now, and before the reef-limestones were deposited in them.

The Fiji group has suffered various movements of subsidence and elevation by which its many islands were affected in unlike ways. Elevation has taken place at different times in different islands, for some of the elevated reefs are elaborately dissected, others are very little dissected, and still others remain at sea-level. The embayments due to the latest submergence of the larger islands, Viti Levu and Vanua Levu, are now largely filled with delta plains. All the reefs, those now elevated as well as those at sea-level, appear to have been formed during periods of subsidence; the evidence afforded by the elevated reefs of Vanua Mbalavu, Mango, and Thithia is specially significant on this point. The medium-sized island of Taviuni has few visible reefs, because its flanks and shores are flooded by sheets of recent lava. The small island of Wakaya seems to be a tilted block of lava beds, not a dissected volcano.

The extensive barrier reef of New Caledonia has grown up during a recent subsidence by which that long and maturely dissected island has been much reduced in size and elaborately embayed; but unlike most encircled islands, this one was strongly cliffed around its south-eastern end, and along much of its north-eastern side before the recent subsidence took place.

The two south-eastern members of the Loyalty group, Maré and Lifu, are former atolls, evenly uplifted about 300 ft.; Maré shows a small hill of volcanic rock in the centre of its limestone plateau or elevated lagoon floor. Uvea, the north-western of the three Loyalty islands, is a slightly tilted atoll; its eastern side shows an uplifted reef in rudely crescentic form, which reaches a height of 100 or 200 ft. at the middle of its crescent, and slowly descends to sea-level at its horns; a bight in its convex front may be the result of a landslide; the tilted lagoon floor slowly deepens westward and is enclosed by disconnected, upbuilt reef-islands.

The New Hebrides show signs of uplift in their elevated reefs, and of depression in their embayments. There is some evidence that certain uplifted fringing reefs on the island of Efaté, near the centre of the group, were formed during pauses in a subsidence that preceded their uplift, and not during pauses in their uplift as inferred by Mawson. The narrowness of the lagoons enclosed by the barrier reefs that encircle certain strongly embayed islands in this group may be explained by supposing alternations of slow and rapid subsidence; thus the earlier-formed reefs, which began to grow when the subsidence was slowly initiated, were drowned when it was later accelerated; and new reefs, thereupon begun on the shore line of that time, now, after a second period of slow subsidence, stand near the present shore line, though the shore line is strongly embayed, because the total subsidence has been large. The absence of reefs around the island of Ambrym is due to its abundant eruptions in recent time, the latest one being in December, 1913; scattered corals were seen growing on one of its sea-cliffed lava-streams, thus illustrating the initial stage of a fringing reef.

The Great Barrier reef of Australia, the greatest reef in the world, with a length of some 1200 miles and a lagoon from 15 to 70 or more miles wide, has grown upward during the recent subsidence by which the Queensland coast has, after a long period of still-stand, been elaborately embayed, as was pointed out by Andrews in 1902. A very recent uplift of some 10 ft. has occurred, as was long ago noted by Jukes. There is much reason for believing that a broadened reef-plain, with extensive land-fed deltas along the continental margin, had been formed before the recent subsidence took place; and it is this broadened reef, now submerged, that is thought to form the "platform" on which the Great Barrier reef has grown up. Guppy's suggestion that the platform or "submarine ledge" is due to marine abrasion, before coral reefs were established here, and that no subsidence has taken place, cannot be accepted. It is highly probable that the well-attested recent subsidence was due to a gentle flexure, by which the offshore sea-bottom was bent down; and, if so, the coastal submergence will give too small a measure of the thickness of the distant barrier reef. In this respect the Great Barrier reef along the shore of a continent differs significantly from smaller barrier reefs around oceanic islands, in which the subsidence of the island and its reefs are essentially uniform.

A few hours on shore at Raratonga, the southernmost member of the Cook group, sufficed to show that extensive embayments formerly entering its elaborately carved mass are now occupied by delta plains and perhaps in part by slightly elevated reef- and lagoon-limestone.

Five islands of the Society group exhibit signs of recent subsidence in their intricately embayed shore lines, as has lately been announced by Marshall. A sixth, the cliff-rimmed island of Tahiti, the largest and youngest of the group, suffered moderate subsidence after its cliffs were cut, but the resulting bays are now nearly all filled with delta plains, which often advance into the narrow lagoon; hence a pause or still-stand has followed its latest subsidence. All the barrier reefs of this group appear to have been formed during the recent subsidence that embayed their central islands.

W. M. DAVIS.

FORMULAS FOR GLASS MANUFACTURE.

THE Institute of Chemistry has sent us an account of the work of the Glass Research Committee appointed by the council of the institute in October last to conduct investigations with the view of arriving at suitable formulas for laboratory glassware, miners' lamp-glasses, combustion tubing, resistant glass for pharmaceutical products, glass for X-ray bulbs, etc. The main part of the report is here reprinted, and is of particular interest at the present time. Copies of the formulas can be obtained from the secretary, Institute of Chemistry, 30 Russell Square, W.C.

Since October, 1914, the research has been continued uninterruptedly, the chief aims being :—(i) to produce working formulas for all glasses used in laboratory work, and (ii) to ascertain the influence of various ingredients on the physical and chemical properties of glasses. The work was extended to include glass for miners' lamp-glasses, at the suggestion of the Home Office; and also glass for ampoules, to meet the needs of wholesale pharmaceutical chemists engaged in the production of army medical requirements. The committee also examined and reported on samples of British and French laboratory glassware, produced since the beginning of the war, a number of the specimens being made from formulas similar to, and in some cases almost identical with, those recommended by the committee.

The committee has had before it many specimens of glasses used for various purposes, of which analyses have been made by Mr. Bertram Blount, Mr. W. C. Hancock, and Mr. Otto Hehner. It has been found, however, that mixtures prepared in accordance with the analytical results were not always satisfactory; but the analyses were helpful in suggesting synthetic experiments, and during recent investigations some intricate analyses made by Mr. G. J. Alderton under the supervision of Mr. Blount have proved especially valuable. Apart from the analyses, the work has been almost entirely carried on at King's College by Prof. Herbert Jackson and Mr. T. R. Merton, and by the former at his own house. The work has involved a careful study of the chemistry of silicates, aluminates, borates, etc., in their relation to the manufacture of glasses.

Up to the present time, the research committee has reported eleven formulas for glasses for various purposes based on the results of about 400 experimental melts on a scale large enough for drawing rods and blowing small vessels. In addition, a very great number of experiments have been made in order to study the influence of the various constituents employed. No formula has been issued without submitting the specimens made to rigorous tests to prove their suitability for the purposes for which they are intended. Moreover, by varying the experimental working conditions, it can be said with reasonable confidence that the mixtures will prove equally satisfactory under the actual working conditions of a glass furnace. The question of workable temperatures has been carefully considered, and, so far as it is possible to judge, the melts on a small scale indicate that even better results will be obtained on the industrial scale. This view has been justified by the samples already received from manufacturers who have tried some of the formulas.

In deciding the formulas it has been found necessary to direct special attention to the proportions of basic and acidic substances in respect of the action of glass mixtures on clay crucibles during fusion, and it has been shown by careful investigation that the formulas proposed give melts in which the influence of the ingredients of the crucibles is very slight and in some cases practically inappreciable.

The following formulas have been communicated to a number of manufacturers who have expressed their interest in the progress of the investigation and to scientific workers who are conducting similar experiments.

Soft glasses, suitable for ordinary chemical laboratory ware.

	Parts		Parts
(1) Sand	67·0	Calcium carbonate	11·6
Sodium carbonate (Na_2CO_3) ...	34·2	Alumina (Al_2O_3)	6·5

A soft glass which does not give up alkali readily to water, works well in the blowpipe, and does not devitrify readily.

	Parts		Parts
(2) Sand	67·0	Calcium fluoride	1·6
Sodium carbonate (Na_2CO_3) ...	29·0	Alumina (Al_2O_3)	8·3
Calcium carbonate	9·6	Boric anhydride (B_2O_3) ...	2·0

A soft glass of higher quality. Does not give up alkali under severe tests. A kindly working glass before the blowpipe, and very difficult to devitrify.

A resistant glass suitable for pharmaceutical purposes, ampoules, etc.

	Parts		Parts
(3) Sand	67·0	Potassium nitrate	1·0
Alumina (Al_2O_3)	10·0	Sodium carbonate (Na_2CO_3) ...	17·0
Calcium carbonate	12·5	Boric anhydride (B_2O_3) ...	8·0
Magnesia ...	0·5		

This glass is intermediate in hardness between soft glass and combustion tubing, is highly resistant to chemical action, withstands changes of temperature well, and should be a very suitable glass for high-class beakers, flasks, etc.

Glasses for combustion tubing.

	Parts		Parts
(4) Sand	68·2	Sodium carbonate (Na_2CO_3) ...	5·5
Alumina (Al_2O_3)	6·2	Boric anhydride (B_2O_3) ...	5·5
Barium carbonate	8·8	Calcium fluoride	1·0
Calcium carbonate	13·0		
Potassium nitrate	4·3		

This glass resembles Jena combustion tubing very closely indeed. It has practically the same fusing point. It fuses on to Jena glass perfectly, and is indistinguishable from it before the blowpipe and in its behaviour on prolonged heating below its fusing point. The presence of the small quantity of calcium fluoride facilitates the incorporation of the ingredients. The sodium carbonate can be reduced to 1·34 parts provided 7·93 parts of anhydrous borax be used in the place of boric anhydride.

	Parts		Parts
(5) Sand	68·2	Sodium carbonate (Na_2CO_3) ...	5·5
Alumina (Al_2O_3)	6·2	Boric anhydride (B_2O_3) ...	5·5
Barium carbonate	8·8		
Calcium carbonate	14·2		
Potassium nitrate	4·3		

This glass is practically of the same composition as (4). It is not so easy to make or to work, but it does not become so opaque as Jena combustion tubing on prolonged heating. As in No. (4), the proportions given for sodium carbonate and anhydrous borax can be substituted for the figures for sodium carbonate and boric anhydride.

Miners' lamp glasses.

	Parts		Parts
(6) Sand	65·0	Potassium nitrate	3·0
Alumina (Al_2O_3)	1·0	Sodium carbonate (Na_2CO_3) ...	14·0
Calcium carbonate	0·6	Boric anhydride (B_2O_3) ...	24·0
Arsenious oxide (As_2O_3) ...	2·0		
Antimony oxide (Sb_2O_3) ...	1·0		

A colourless and fusible glass withstanding rapid changes of temperature exceptionally well.

	Parts		Parts
(7) Sand	65·0	Potassium nitrate	3·0
Alumina (Al_2O_3)	1·0	Anhydrous borax ($Na_2B_4O_7$) ...	26·68
Calcium carbonate	0·6	Boric anhydride (B_2O_3) ...	5·5
Arsenious oxide (As_2O_3) ...	2·0		
Antimony oxide (Sb_2O_3) ...	1·0		

The same glass as (6), but the ingredients have been varied to avoid the use of so much boric anhydride, which is at present apparently difficult to obtain on a commercial scale.

Resistance-glass.

	Parts		Parts
(8) Sand	65·5	Sodium carbonate (Na_2CO_3) ...	10·2
Alumina (Al_2O_3)	2·5	Borax anhydrous ($Na_2B_4O_7$) ...	13·0
Magnesia (MgO)	5·0		
Zinc oxide (ZnO)	8·0		

A glass almost identical in its general behaviour with Jena resistance glass; withstands changes of temperature well, but, like Jena, is not suitable for working before the blowpipe. It darkens and tends to devitrify; operations—such, for instance, as sealing side tubes into flasks—are difficult, if permanent and neat joints are required.

Formula No. 3, recommended for pharmaceutical purposes, ampoules, etc., may be substituted for the resistance glass with advantage, as the ampoule glass lends itself very well to blowpipe work, and is also especially resistant chemically.

Alternative for combustion tubing.

	Parts		Parts
(9) Sand	72·0	Potassium nitrate (KNO_3) ...	3·0
Alumina (Al_2O_3)	10·0	Sodium carbonate (Na_2CO_3) ...	11·2
Calcium carbonate	11·0	Borax anhydrous ($Na_2B_4O_7$) ...	7·2
Magnesia (MgO)	0·5		

This glass is capable of withstanding high temperatures and rapid changes of temperature; works well before the blowpipe, and is free from the chief defect of Jena glass—namely, the readiness with which it becomes cloudy, and finally quite opaque after prolonged use.

By slight modifications of this formula, almost any degree of hardness can be obtained.

In formulas (8) and (9) substances such as magnesia (MgO) and zinc oxide (ZnO) can be added in the form of carbonates if the actual percentages of MgO and ZnO respectively present in the carbonates are known.

Soft soda-glasses suitable for tubing and for X-ray bulbs.

	Parts		Parts
(10) Sand	68·0	Potassium nitrate (KNO_3) ...	14·5
Alumina (Al_2O_3)	4·0	Sodium carbonate (Na_2CO_3) ...	26·0
Calcium carbonate ($CaCO_3$)	12·8		

	Parts		Parts
(11) Sand	68·0	Potassium carbonate (K_2CO_3)	10·0
Alumina (Al_2O_3)	4·0	Sodium carbonate (Na_2CO_3)	26·0
Calcium carbonate	12·8		

These glasses do not lose their easy-working qualities after repeated heating and blowing, and are plastic over a long range of temperature. They require a temperature of at least 1400–1500° C. for complete incorporation of the ingredients in order to obtain that homogeneity which is necessary for resistance to rapid changes of temperature and ease of working before the blowpipe.

No. (10), containing potassium nitrate, is considered the better of the two, and is more easily incorporated.

The committee considers that the formulas obtained and the work done on the various glasses justify it in the opinion that there is now information available for the manufacture of all the important glasses used in the laboratory and for industrial purposes, which have hitherto been mainly obtained from abroad.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

LONDON.—Prof. T. G. Brodie, professor of physiology in the University of Toronto, will deliver a course of four lectures on "The Gases of the Blood" at King's College, London, on May 31, June 2, 7, and 9. These lectures take the place of those previously announced; they are free to medical students, to internal students of the University, and to medical men on presentation of their cards.

MR. A. G R. FOULERTON has been appointed lecturer in public health at the London (Royal Free Hospital) School of Medicine for Women, in succession to Prof. W. J. Simpson, resigned.

THE Education Committee of the County Council of the West Riding of Yorkshire has arranged a summer vacation course for teachers, which is to be held at Bingley Training College from August 4 to 18 next. Four evening lectures will be given during the course, including one by Mr. Mackinder on how much geography and history can be taught within the limits of the elementary school. The general course makes provision among numerous other subjects for lectures on the teaching of informal domestic work in schools, and the special courses include lectures on animal and plant life. The primary object of the courses is to increase the educational spirit and efficiency of persons teaching in the West Riding, and to enable them to supplement their knowledge of the various subjects, and of the most approved methods of teaching them. All particulars of the course, including time-tables, are given in the "Bingley Vacation Course Syllabus," copies of which may be obtained on application to the Education Department, County Hall, Wakefield.

ON March 6, Lord Hardinge, Viceroy of India, presided over the annual convocation of Calcutta University, and delivered an address in his capacity of Chancellor of the University. The address is printed in the issue of the *Pioneer Mail* for March 12. The Chancellor referred to the increased interest which has arisen in Indian universities in the teaching of science subjects. University inspection combined with an ordered procedure in affiliation has considerably raised the standard of instruction in the colleges. Some of the laboratories attached to these institutions can now compare favourably with any in the world. The teaching staffs have been strengthened. The

advanced students produce papers dealing with subjects of research which are accepted by leading scientific journals in Europe. In the past years the Government of India has contributed generously to the capital requirement of the University of Calcutta, which also draws an annual sum, the capitalised value of which is 36½ lakhs, and generous gifts have been received recently from the late Sir Taraknath Palit and Dr. Rashbehari Ghosh. In Bombay the contributions of few public-minded citizens to the proposed Royal Institute of Science have totalled nearly 25 lakhs, while Sir Chinubhai Madhav Lal has endowed the Institute of Science of Ahmedabad with six lakhs, giving a further two lakhs to the Gujerat College, with which it is associated. Lord Hardinge also dealt with the question of university buildings and libraries. The universities of India have recently made laudable efforts, which have been substantially aided by the Government, to provide for themselves local habitations in the shape of buildings befitting their dignity, and libraries where their alumni may learn the use of books and the methods of investigation and research which collections of books alone make possible. Calcutta has not been behindhand. Thanks to the generosity of the Maharaja of Darbhanga, the University is now possessed of a handsome library. The students of the Law College are accommodated in a hostel towards which the Government contributed three lakhs. The Government has also made a grant of eight lakhs for the purchase of a valuable site which abuts on the University buildings, and the acquisition of which should permit of further extension.

SOCIETIES AND ACADEMIES.

LONDON.

Physical Society, March 26.—Dr. A. Russell, vice-president, in the chair.—Prof. A. W. **Porter** and F. **Simeon**: The change of thermal conductivity with fusion. The change in question was determined for mercury and for sodium by finding the temperatures at different points of a cylinder of the metal contained in a glass tube. The ends of the cylinder were maintained at such temperatures that the metal was liquid half-way down its length, the remaining part being solid. The temperatures were taken by means of thermo-electric junctions inserted in narrow tubular depressions which had been formed in the glass tube by forcing a knitting needle down into the locally heated glass. The ratio of the thermal conductivity for solid and liquid was estimated from the slope of tangents drawn to the temperature-curve on each side of the melting point. The values of these ratios are of the same order as the ratio of the corresponding values of the electrical conductivities. The mean value for mercury is 3·91, and for sodium 1·31.—Dr. J. A. **Fleming**: An instrument for the optical delineation and projection of physical curves such as hysteresis, resonance, and characteristic curves. This instrument is designed for projecting on to a screen or photographing on a plate such curves as magnetic hysteresis, resonance, or characteristic curves which can be performed slowly, or are non-periodic or non-repetitive.—Dr. P. **Phillips** and J. Rose **Innes**: The stability of some liquid films. The authors give a simple method of calculating the equilibrium form of a thin film which is a surface of revolution. They then consider the stability for certain kinds of displacement of three classes of such films, viz., the sphere, the cylinder and the catenoid. The mathematics used is quite elementary throughout and the treatment is rigorous.—Prof. A. W. **Porter** and E. Talbot **Paris**: A demonstration of the green-flash of the setting of an artificial sun. A large disc of card mounted so that it can be slowly rotated has a hole, 1 in. in diameter, cut in it about 2 in. from the periphery. This is covered with red gelatine films, and is illuminated from behind so as to form an artificial sun. The front of the disc is covered with white Bristol board and is moderately illuminated by a lamp in front. This sun is viewed through a rectangular aperture (4 in. wide) in a blackened board, the lower edge of the aperture serving as the horion. When the disc is rotated the artificial sun sets and green after-images are obtained of characters varying according to the amount that the eye has been exposed to the bright sun. If the sun is not viewed until immediately before the complete setting the after-image represents simply the disappearing segment to which it is due. The authors claim that this phenomenon is what is often described as the green-flash at sunset, though they are ready to admit that other (but probably rarer) phenomena also go under the same name.

MANCHESTER.

Literary and Philosophical Society, March 23.—Mr. F. Nicholson, president, in the chair.—T. A. **Coward**: A note on the behaviour of a blackbird—a problem in mental development. The author referred to the habit of certain birds—individual, not specific—which when stirred by spring rivalry will fight with their own reflections as seen in windows, and spoke, in particular, of a male blackbird which for more than a month has been daily assaulting its own image in a particular window. A blackbird, presumably the same, behaved in a similar way at the same window all through last spring. Attention was directed to the psychological problem presented by a bird with an excellent memory but without any apparent power of learning by experience. The recollection of this visionary antagonist was stimulated by the seasonal sexual activity and died down with the normal waning of this force.—A. W. Rymer **Roberts**: Two cases of parallelism in the Aphidæ. Parallel series of aphids may co-exist on the same or on different plants, having the same ancestry but differing in habits and sometimes also in form. The phenomenon was first brought in prominence by Cholodkovsky's recent researches on Chermes. Though there exists some doubt, in the light of more recent research, whether the instances principally relied upon are not those of distinct biological species, other instances have been discovered of as many as four parallel forms being descended from the winter-form on the secondary host-plant in certain species of Chermes. Parallelism exists also in other groups, as in the Pemphiginæ, two instances observed being (1) *Thecabius affinis*, a species migrating between poplars and Ranunculus, and (2) *Hamamelistes tullgreni*, so far only found on birch. *T. affinis* has been found continuing to live over the winter on Ranunculus after the migrating individuals have returned to the poplar. *H. tullgreni* has been observed in England for the first time during the past year. Certain of its forms resemble scale insects. It has so far only been found upon birch, but winged individuals fly from that to some other plant, leaving wingless individuals to continue the race on the birch, both being descended from a single ancestress by parthenogenesis.

EDINBURGH.

Royal Society, March 1.—Prof. Hudson Beare, vice-president, in the chair.—H. **Levy**: The resistance of a fluid to a body moving through it. In this paper

it was shown that trails of vortices following in the wake of a body moving through a fluid did not form a stable system, so that the theory recently advanced by Karman, which was based upon a suggestion made originally by Kelvin, did not seem to be tenable. The paper also contained an interesting development of the method of finding the stream lines with certain definable forms of boundary.—F. D. **Miles**: The electrical conductivity of aqueous hydrochloric acid, saturated with sodium chloride; and on a new form of conductivity cell. Within the range of concentration (15 to 27 per cent. of hydrogen chloride) the specific conductivity is lowered by saturation with salt. The salt-saturated acid of maximum conductivity was prepared by adding salt to a solution containing 21·9 per cent. of hydrogen chloride, whereas the best conducting solution of hydrogen chloride alone contains only 19·1 per cent. of that substance. The conductivity cell described was specially suitable for solutions which are saturated or contain volatile constituents.—F. D. **Miles**: The reaction between sodamide and hydrogen. At temperatures near to 250° C. these substances react according to the formula, $NaNH_2+H_2=NaH+NH_3$.

March 15.—Prof. Bower, vice-president, in the chair.—Dr. J. H. **Ashworth**: The larvæ of Lingula and Pelagodiscus. Sixteen larvæ of *Lingula anatina* were taken by him last year in the surface waters of the southern part of the Red Sea, and one in the Indian Ocean about 4° south of Colombo. The latter is noteworthy because of the depth of water (2200 fathoms) in the locality where the larva was taken. The larvæ varied from 0·5 to 1·6 mm. in length. Descriptions were given of the alimentary canal, calomoducts (nephridia), and statocysts, and of the changes in shape of the shell valves as growth proceeds. An account was also given of the anatomy of the larva of *Pelagodiscus* (*Discinisca*) *atlanticus*, based on six specimens, about 0·4 mm. in length, which were taken in October last a few miles west of Cape Cormorin in water of 40 fathoms. Adult specimens of this Brachiopod have almost entirely been recorded from deep water. Blochmann has denied the presence of statocysts in both Lingula and Pelagodiscus, but these organs were certainly present in both genera.—C. **Cochrane**: The reflective power of pigments in the ultra-violet. The diffuse reflection from the prepared strip of pigment, which was illuminated by a complete iron-arc spectrum, was photographed, a similar photograph of the reflection from a contiguous strip of white cardboard being simultaneously taken as a standard of comparison. More than thirty different pigments were experimented with, and of these the greater number showed selective reflection in the higher ultra-violet. There were, however, marked exceptions, such as Chinese white, the reflective power of which rapidly diminished as the wave-lengths became shorter.—Dr. W. T. **Gordon**: Archæocyathinæ collected by the Scottish National Antarctic Expedition. The specimens were obtained in a block of limestone dredged in the Weddell Sea, and associated with them were remains of calcareous algæ and sponges. The Archæocyathinæ can be grouped under the genera Archæocyathus, Spirocyathus, Coscinocyathus, Syringocnema, and Protopharetra. The fauna shows striking similarity with that described by Taylor from the Cambrian rocks of South Australia.

PARIS.

Academy of Sciences, April 6.—M. Ed. Perrier in the chair.—G. **Bigourdan**: The instrumental undulations of images; their daily and annual variation and their relation with the general state of the atmosphere. A discussion of the causes and means of elimination of the irregular movements of the focal images of stars.—Paul **Appell**: The approximate inversion of certain real integrals, and on the extension of Kepler's equation and Bessel's functions.—L. E. **Bertin**: Calculation of the increase of velocity or of range of submarines resulting from increase of their dimensions. Data furnished by ordinary vessels are not directly applicable to submarines. It would appear that the maximum speed and range will be reached for a submarine having a displacement at the surface of 1000 tons.—Maurice **Hamy**: Radiography in the hospital at the Institute. Radiographs of all the wounded are made as they enter the hospital in the same attitude on two distinct plates, the bulb being moved a distance of 7 cm. The negatives, examined in a specially constructed stereoscope, show the position of the metallic fragment or damaged bone in relief, by means of which the operation is much simplified.—M. **Guignard**: The formation of pollen.—J. **Bosler**: The rotation of the solar corona. Measurements of the red line of wavelength 6374·4 on the east and west borders gave by the application of the Doppler-Fizeau principle a tangential velocity of 3·7 kilometres per second, with a possible error of 25 to 30 per cent. This agrees well with the determination of W. W. Campbell, who by applying the same method to the green line 5303 obtained a velocity of 3·1 kilometres per second. Hence the corona moves in the same sense as the direction of movement of the sun, and apparently with a higher velocity.—H. **Deslandres**: Remarks on the preceding communication and on problems connected with the rotation of the solar corona. The study of the corona throws light on the important question of a corpuscular radiation emitted by the sun and received by the earth, but increase of knowledge in this direction must necessarily be slow, since the corona is only observable during eclipses.—Daniel **Berthelot**: The temperature-coefficient of photochemical reactions. For the changes studied, the decomposition of lævulose and the decomposition of a mixture of oxalic acid and ferric chloride the rate of photochemical change is increased by a rise of temperature, but the coefficient is very much smaller than that of an ordinary chemical change.—Henri **Coupin**: The resistance of marine bacteria to the action of salt. Marine bacteria have tolerance for a considerable range in the proportion of salt in the water in which they develop, as they can support 8 per cent., and are content with as little as 0·3 to 0·2 per cent. They adapt themselves better to proportions lower than the normal sea-water salt-content than to more concentrated solutions.—C. **Sauvageau**: The development and the biology of *Saccorhiza bulbosa*.—J. **Bergonié**: The detection and localisation of magnetic projectiles by an electromagnet actuated by an alternating current. The vibration of the flesh immediately over the metallic fragment gives an accurate indication of its position. Details are appended of several operations successfully carried out by this means.—MM. **Belot** and Maxime **Ménard**: The use of the Coolidge tube in the medico-surgical applications of the X-rays. The Coolidge tube is based on the discharge of independent electrons and details are given of a pattern made in France by Pilon. The advantages obtained, as compared with the ordinary tube, are the regularity in working, the long period of regular working, the possibility of regulating the tube without modifying the vacuum, the fixed point of impact on the kathode, and the homogeneity of the bundle of X-rays.—Miramond **de Laroquette** and Gaston **Lemaire**: Tables of the coefficients of magni-

fication of radiographic images utilisable for the localisation of projectiles in the tissues.—Pierre **Delbet** and H. **Vaquez**: Chondrectomy in certain irreducible dilations of the right heart.

BOOKS RECEIVED.

British Museum (Natural History). Report on Cetacea Stranded on the British Coasts during 1914. Pp. 16. (London: British Museum (Natural History); Longmans and Co.) 1*s.* 6*d.*

British Museum (Natural History). British Antarctic (*Terra Nova*) Expedition, 1910. Natural History Report. Zoology. Vol. i., No. 2. Natural History of the Adelie Penguin. By Staff-Surgeon G. Murray Levick. Pp. 55–84+plates i–xxi. (London: British Museum (Natural History); Longmans and Co.) 5*s.*

Memoir on the Economic Geology of Navanagar State in the Province of Kathiawar, India. By E. H. Adye. Pp. xxvi+262. (Bombay: Thacker and Co., Ltd.)

The Manchester Museum. Museum Handbooks: The Stela of Sebek-khu. By T. E. Peet. Pp. 21. (Manchester: University Press.) 2*s.*

The Plateau Peoples of South America. By A. A. Adams. Pp. 134. (London: G. Routledge and Sons, Ltd.) 3*s.* 6*d.* net.

An Amateur's Introduction to Crystallography. By Sir W. P. Beale. Pp. vii+220. (London: Longmans and Co.) 4*s.* 6*d.* net.

The Panama Canal. By R. E. Bakenhus, Capt. H. S. Knapp, and Dr. E. R. Johnson. Pp. xi+257. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd.) 10*s.* 6*d.* net.

Heating and Ventilating Buildings. By Prof. R. C. Carpenter. Sixth edition. Pp. xiv+598. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd.) 15*s.* net.

DIARY OF SOCIETIES.

THURSDAY, APRIL 15.

ROYAL INSTITUTION, at 3.—The System of the Stars: Star Colour and its Significance: Prof. A. S. Eddington.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—The Power Supply of the Central Mining-Rand Mines Group: J. H. Rider.

LINNEAN SOCIETY, at 5.—Experiments and Observations bearing on the Interpretation of Form and Coloration in Plants and Animals: C. F. M. Swynnerton.

INSTITUTION OF MINING AND METALLURGY, at 8.—The Precipitating Action of Carbon in Contact with Auriferous Cyanide Solutions: W. R. Feldtmann.—Cyaniding of Gold-Silver Ores at Waihi Grand Junction: N. Carless.—The Effect of Mineralised Waters in Cyanide Plants: T. B. Stevens and W. S. Bradley.

FRIDAY, APRIL 16.

ROYAL INSTITUTION, at 3.—The Russian Idea: S. Graham.

INSTITUTION OF MECHANICAL ENGINEERS, at 8.—President's address: Dr. W. Cawthorne Unwin.

SATURDAY, APRIL 17.

ROYAL INSTITUTION, at 3.—Modern Artillery: Lieut.-Col. A. G. Hadcock.

MONDAY, APRIL 19.

VICTORIA INSTITUTE, at 4.30.—The Zoroastrian Doctrine of a Future Life: Prof. J. Hope Moulton.

TUESDAY, APRIL 20.

RÖNTGEN SOCIETY, at 8.15.—Late Radium and X-Ray Burns: Dr. N. S. Finzi.—A New Alpha Ray Effect: F. H. Glew.

ROYAL STATISTICAL SOCIETY, at 5.15.—The Progress of Friendly Societies and other Provident Institutions during the Ten Years 1904–1914: Sir Edward Brabrook.

WIRELESS SOCIETY, at 8.—Methods of the Measurement of the Strength of Wireless Signals: Dr. E. W. Marchant.

WEDNESDAY, APRIL 21.

ROYAL METEOROLOGICAL SOCIETY, at 7.30.—A Study of the Moving Waves of Weather in South America: H. Helm Clayton.—The Correlation between Changes in Barometric Height at Stations in the British Isles: E. H. Chapman.

THURSDAY, APRIL 22.

ROYAL SOCIETY, at 4.30.—*Probable Papers:* Deep Water Waves, Progressive or Stationary, to the Third Order of Approximation: Lord Rayleigh.—A Chemically Active Modification of Nitrogen, produced by the Electric Discharge. VI.: Hon. R. J. Strutt.—The Difference between the Magnetic Diurnal Variations on Ordinary and Quiet Days at Kew Observatory: Dr. C. Chree.—The Effects of Different Gases on the Electron Emission from Glowing Solids: F. Horton.—Heats of Dilution of Concentrated Solutions: W. S. Tucker.—The Origin of the "4686" Series: T. R. Merton.

ROYAL INSTITUTION, at 3.—The System of the Stars: The Stellar System in Motion: Prof. A. S. Eddington.

FRIDAY, APRIL 23.

ROYAL INSTITUTION, at 9.—Military Hygiene and the War: Major P. S. Lelean.

INSTITUTION OF MECHANICAL ENGINEERS, at 8.

PHYSICAL SOCIETY, at 5.—The Theories of Voigt and Everett Regarding the Origin of Combination Tones: Prof. W. B. Morton and Miss Mary Darragh.—Experiments on Condensation Nuclei Produced in Gases by Ultra-Violet Light: Miss Maud Saltmarsh.—The Self-Induction of Solenoids of Appreciable Winding Depth: S. Butterworth.

SATURDAY, APRIL 24.

ROYAL INSTITUTION, at 3.—Modern Artillery: Lieut.-Col. A. G. Hadcock.

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Editorial and Publishing Offices:

MACMILLAN & CO., LTD.,

ST. MARTIN'S STREET, LONDON, W.C.

Advertisements and business letters to be addressed to the Publishers.

Editorial Communications to the Editor.

Telegraphic Address: PHUSIS, LONDON.

Telephone Number: GERRARD 8830.

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